JULY 25, 1960

Published every-other-Monday Seventy-five cents

Chemical Engineering

-Fresh water from the sea: Five plants will explore five processes — page 105

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> IS THE GRASS GREENER ON THE BOSS'S SIDE? . . . P. 127 COSTS OF PLATE-AND-FRAME FILTERS . . . P. 132 ONE WAY TO SLICE TOWER DOWNTIME . . . P. 134



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Effective filtration of a broad category of rapid settling and dewatering slurries that require intensive washing can be accomplished only on horizontal pan filters especially designed for this feed.

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Koroseal keeps contamination out of cleaning compounds

Koroseal PVC pipe, by B.F.Goodrich, ends corrosion too

EVEN stainless steel can't handle some of the chemicals used in this plant. Corrodes too fast! But the real problem is that metal pipe would contaminate some of the commercial cleaning compounds produced here. That's why Koroseal PVC pipe was installed on all lines where corrosion or contamination could cause trouble.

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Koroseal was first tried out by the Zep Manufacturing Corp., Atlanta, Ga., about 10 years ago. Since then, they've found many more uses for it, and have never had to make a replacement because of chemical corrosion. Installation is simple. Koroseal pipe can bethreaded, welded, cemented. And according to Zep's engineers," component fittings, valves and pipe fit together like the parts of a fine watch."

More and more manufacturers are finding Koroseal PVC pipe ideal for use wherever chemical resistance, high working pressures, good impact resistance are factors. Longer service life and low installation costs make rigid Koroseal competitive with conventional piping material.

For the full story on Koroseal's

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B.F.Goodrich Koroseal rigid PVC products



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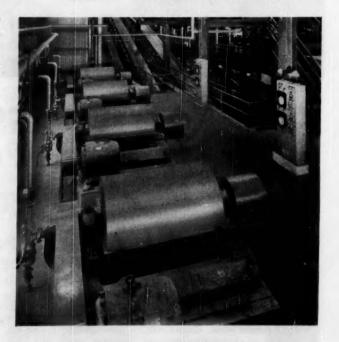
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The Bird Solid Bowl Centrifugal was called a continuous Centrifugal to distinguish it from batch machines. But its users will tell you that the word "continuous" describes its performance as well. From the moment they're installed, push button start-ups are taken for granted. They run and keep on running without a hitch. If you've ever operated a Bird we don't have to tell you this. If you haven't, ask any of its hundreds of users if this isn't one of the outstanding advantages of Bird Solid Bowl Centrifugals.

For example, we recently came across a Bird that has handled a BILLION POUNDS of salt. In the course of a routine annual check-up on a Bird that has been running 20 hours a day every day in the year it was discovered that it had been doing so for twenty-three years, during which it had separated 1,007,400,000 pounds of salt from caustic.

Isn't this the equipment to handle your solid-liquid separations?

The Bird Research and Development Center is equipped to determine, without bias, whether it's the one best way to do the job, because Bird builds all types — batch centrifuges, continuous screen as well as solid bowl centrifugals, drum and pan vacuum filters and pressure filters. Let us help you to accomplish solid-liquid separations that require only the push of a button.





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CHEMENTATOR Top Chemical Developments and What They Mean, 53 What's New and Significant in Research, 60

PROCESSES & TECHNOLOGY Electrolysis Saves Chlorine in Waste, 63 New Process Gets Ultimate Safeguards, 68

CHEMICAL ECONOMICS Resins' Stake in Easy-Care Cotton, 74

Newsworthy Chemicals & Raw Materials, 78 **NEW CHEMICAL PRODUCTS**

NEW PROCESS EQUIPMENT Basket Extractor Keeps Beds Stationary, 84 Mull It Over Continuously With New Mixer, 86 Equipment Cost Index, 172

PROCESS FLOWSHEET New Plant Counters Helium Shortage, 96

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YOU & YOUR JOB That Other Grass Is Always Greener, 127*

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SILICON TETRAFLUORIDE ANOTHER FIRST FOR HARSHAW

Harshaw's newest fluoride is silicon tetrafluoride. One of the major oil companies has just developed a process for sealing water out of oil wells during drilling with this newly introduced fluoride.

In 1904 when The Harshaw Chemical Co. first started to manufacture hydrofluoric acid, all of the production was used by foundries to remove sand from iron castings. Today, Harshaw's fluoride division produces 26 different fluoride chemicals for as many industries.

The major uses of Harshaw Fluorides are in the petroleum, glass, steel, and atomic energy industries. Even in these industries the uses are diversified. The versatility of Harshaw fluorides is also evident by their use in soldering fluxes, cleaning boilers, removing iron stains and souring laundry, curing plastics, alloying aluminum, floating minerals, sanitizing breweries, and treating water.

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Chemical Engineering

July 25, 1960

PRINT ORDER OF THIS ISSUE 52,671

CE COST FILE

Plate-and-Frame Filters, J. L. Hutton, Jr., 132

OPERATION & MAINTENANCE

Retraying Bubble Cap Columns, James Tipton, 134

PROCESS DESIGN NOTEBOOK

"Hypodermic Still" Gives Vapor-Liquid Data, Paul J. Horvath, 142 Pressure-Enthalpy Plot for Dowtherm A, Frank Maslan, 146 Chart Finds Heat Loss Rate, J. F. Kuong, 146

CORROSION FORUM

How to Extend Storage-Tank Life, C. K. Aldrich, 148

OTHER REGULAR FEATURES

Industry News, 72, 154
Convention Calendar, 162
More New Equipment Developments, 164
Technical Bookshelf, 174
Letters: Pro & Con, 178
Classified Section, 204
Equipment Searchlight, 205

READER SERVICE

Reader Service Postcard, 185 Reprints Now Available, 187 Guide to Technical Literature, 188 Advertisers in This Issue, 210

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the subscription price applying to copies not yet mailed.

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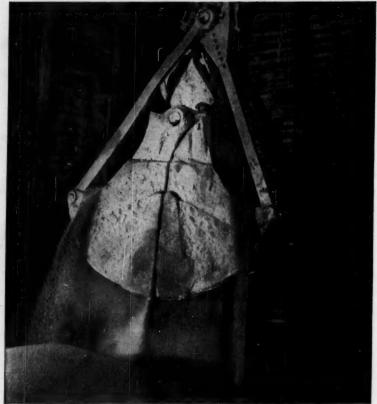
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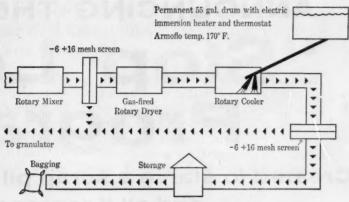
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New cure for caking and dust problems: **Armoflo** 65





July 25, 1960—CHEMICAL ENGINEERING



Dust is a common problem to all fertilizer manufacturers.

Now the Armour Industrial Chemical Company offers an effective solution with Armoflo 65 and other Armoflo formulations. Originally developed as cationic anti-caking agents for hygroscopic materials, these compounds display excellent dust control as well. The Jeffersonville, Indiana, plant of the Armour Agricultural Chemical Company has just completed the first season of production using Armoflo 65. W. C. Brodfuehrer, Plant Superintendent, summed up by observing, "I'd say there was an overall improvement of about 75%."

Results in Jeffersonville also show that caking is no longer a problem. To use the Armoflo formulations most effectively, personnel at Jeffersonville made minor revisions in the plant layout as illustrated in the flow diagram above and explained in the accompanying description.

Trade Name	MP°C Average	Recommended Anti-Caking Uses
Armoflo 65* (Cationic)	5°	 Hygroscopic Fertilizers and Salts Sulfur Thermosetting Plastics
Armoflo 66 (Cationic) (New)	34°	Highly Hygroscopic Salts and Fertilizers
Armoflo 48* (Anionic) (New)	-3°	Hygroscopic Sodium and Calcium Salts

^{*}Also recommended for dust control

General Recommendations

Armoflos are preferably applied warm to hot—dripped, sprayed, or fogged—to materials in the range 100-250° F. Thorough mixing should follow, preferably in rolling equipment, to secure the hydrophobic monomolecular Armoflo layer which imparts protection against caking and to which fine dust particles adhere. Method of addition, for these Armoflos, is as received.

Plant Operation

Armour Agricultural Chemical Company Jeffersonville, Indiana

The fertilizer base goods are fed into the granulation plant where they are intimately treated with water and liquid reactants. Screening is done next to avoid recoating the circulating load. The reaction mixture is then dried in a gas fired rotary dryer, and passed to a counter-current rotary cooler. The Armoflo, at 1#/T, is sprayed into the cooler through 2 nozzles at the point of air intake. Both sufficient heat to hold the Armoflo in a fluid. mobile state and proper mixing to insure thorough and complete spreading of the Armoflo are available at this point. The dryer exit or cooler entrance also would be satisfactory points of addition on the basis of these temperature and mix characteristics. The cooled fertilizer is screened to eliminate the undersize caused by attrition, and then the product is bagged for shipment.

We will be pleased to provide additional information and samples for your evaluation at your request.

Armoflo Booklet.			
Armoflo Samples	48	65	66
NAME			
TITLE			
COMPANY			
ADDRESS			
CITY	ZONE	STAT	E

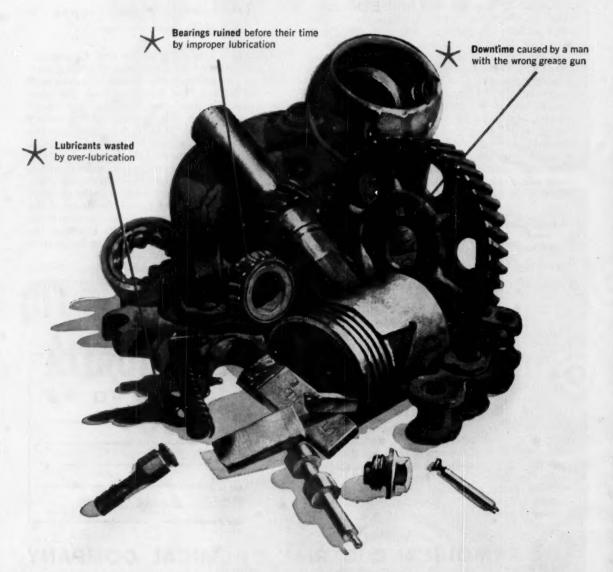


ARMOUR INDUSTRIAL CHEMICAL COMPANY

O Division of Armour and Company / 110 North Wacker Drive · Chicago 6, Illinois

"Stop Loss" Program

Created to starve a scrap pile at its source... and all it represents \star



LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

Even though your plant is already an efficient operation, a Texaco "Stop Loss" Program can yield important savings in maintenance. production, purchasing and inventory.

What it is; why it will work for you. The Texaco "Stop Loss" Program is a complete package specifically designed to modernize your lubrication practices-to keep pace with your updated production and marketing procedures. "Stop Loss" is based on our years of experience in organizing lubrication in the chemical industry.

If yours is an average chemical plant, the adoption of this program will actually show up on your profit sheet. That's because the savings from "Stop Loss" go directly into net profits.

Lubrication, far from being an expense item, is actually one of your most effective cost control tools!

HERE'S WHAT YOU NEED TO HELP STARVE YOUR SCRAP PILE

These components of the Texaco "Stop Loss" Program are available to interested plant groups:

- 1. New 20-minute sound-color film "Stop Loss with Organized Lubrication"-created to show the many opportunities for cost control through organized lubrication practices.
- 2. A Lubrication Control System that takes the guesswork out of lubrication scheduling. It costs almost nothing to install, yet can save as much as 15% of your maintenance costs.
- 3. A film "package" for various departments. This consists of educational films that cover the selection and application of greases, hydraulic oils, cuttings oils, etc.
- 4. Co-ordinated booklets on the film subjects plus many others that can be used as guides in specific areas.

We believe that a modern Texaco "Stop Loss" Program will produce a package of economies in your chemical plant.









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See why ALCOA ALUMINUM makes a good design habit

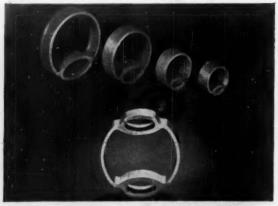
Requirement: Simple, low-cost heated lines to pipe high viscosity fluids Key to Good Design: Specify UNITRACE and DUOTRACE, Alcoa's extruded aluminum pipes with integral steam chambers

With the development of UNITRACE® Piping, ALCOA created an entirely new technique for piping viscous fluids. Trace and product chamber are extruded in a single unit of light, strong, corrosion-resistant ALCOA® Aluminum. This integral steam-traced pipe eliminates the need for cumbersome, costly, inefficient pairing of separate pipes for steam and product. The resultant savings in initial cost are coupled with a major increase in the efficiency of heat application to the product piped.

Subsequent development of special flanges, elbows, adapter flanges and UNITRACE Trace Caps has made it possible to design and install completely integrated UNITRACE piping systems...compatible with standard pip-

ing components.

Now ALCOA has developed a new product, DUO-TRACE,* to expand the design range of integrally traced piping systems. DUOTRACE contains not one but two trace chambers plus a product chamber in a single ex-*Trademark of Aluminum Company of America



Fittings and connections for UNITRACE and DUOTRACE: Unflanged connections can be made easily and effectively with the special UNITRACE Trace Cap. As illustrated, trace chambers in adjoining sections are cut back and a circumferential weld is made to seal the product chamber. The cut back trace section is then covered with a UNITRACE Trace Cap welded in place with 4043 weld wire. Simple, efficient flanged connections utilize special UNITRACE flanges designed to accommo-

truded aluminum pipe. This makes DUOTRACE the perfect solution to the need for recirculating tracing systems.

Today, the ingenuity of process industries designers has indicated intriguing new areas of potential use for both UNITRACE and DUOTRACE. Consider, for instance, the process economies which can result from the substitution of either UNITRACE or DUOTRACE for unit heat exchangers and preheaters.

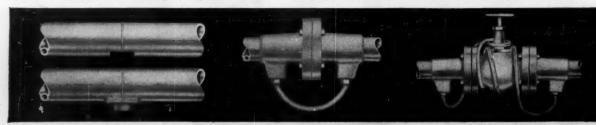
Here you see an outstanding example of the way in which Alcoa is putting over 40 years of process industries experience to work to make aluminum your good design habit. You are invited to share that experience—through a series of engineering conferences which Alcoa is holding this year in a number of major cities. Your local Alcoa sales office will be happy to furnish details.

Take advantage, too, of the body of ALCOA literature which describes in technical detail the known performance characteristics of aluminum in a variety of process industries applications. Simply fill in and mail the coupon opposite. ALUMINUM COMPANY OF AMERICA, Alcoa Building, Pittsburgh 19, Pa.

World wide sales through ALCOA INTERNATIONAL, INC., 230 Park Avenue, New York 17, N.Y.

The development of DUOTRACE has opened broad new areas of design exploration in the field of heat transfer. By adding a second trace chamber to the one previously available in UNITRACE, DUOTRACE permits recirculation of the trace fluid. This opens up a whole new area of heat transfer design. Not the least of the possibilities is this: certain types of heat exchangers may now be extruded as single units. The cost savings implicit in such a unit are almost staggering. Alcoa engineers will be happy to assist you in exploring such design innovations in your own plant or process.

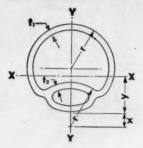
date both trace and product chambers. Jumper connections are used to carry the trace across the connection, and special impingement plates in the flange shield the product chamber from erosion as steam passes through the flange. Valves, pumps and other fittings can be incorporated into the traced systems by using UNITRACE flanges which mate with all 150-lb ASA flanges, valves and pumps. UNITRACE and DUOTRACE systems accommodate standard preformed pipe insulation.



UNFLANGED CONNECTIONS

FLANGED CONNECTIONS

VALVES AND FITTINGS



	Unitrace Sizes	1 in.	11/2 in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) in. ⁴ Radius of Gyration (R) in. Section Modulus (S) in. ³	.09 .37 .13	.34 .58 .34	.72 .72 .56	2.71 1.09 1.42	6.52 1.42 2.65	31.82 2.12 8.73	81.82 2.78 17.22
Axis YY	Moment of Inertia (I) in. ⁴ Radius of Gyration (R) in. Section Modulus (S) in. ³	.09 .37 .14	.33 .57 .34	.70 .71 .59	2.65 1.08 1.52	6.36 1.40 2.83	29.72 2.05 8.97	76.70 2.69 17.79

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	.657	.950	1.187	1.750	2.250	3.312	4.312
t,	.133	.145	.154	.170	.187	.280	.322
t ₂	.145	.163	.174	.185	.200	.307	.354
× 1	.133	.344	.406	.625	.813	1.500	2.000
v	.61	.87	1.08	1.59	2.03	2.98	3.87



	Duotrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis	Moment of Inertia (I) in.4			.80	3.06	7.53	BEN THE	
XX	Radius of Gyration (R) in.	1 14 3		.74	1.12	1.46	-	100
30	Section Modulus (S) in.3	-		.68	1.75	3.35		-
Axis	Moment of Inertia (I) in.4	THE PARTY	F-12-17	.67	2.59	6.29	100	
YY	Radius of Gyration (R) in.	100		.68	1.03	1.33	-	-
(32/33)	Section Modulus (S) in.3	_	SALES OF SALES	.57	1.48	2.80	-	1000

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r t,	E 48	Mas and	1.187	1.750	2.250		
t ₂ X	等国的		.174	.185 .843	.200 1.125		

Unitrace-Duotrace Sizes	1 in.	1½ in.	2	in.	3	in.	4	in.	6 in.	8 in.
Product Area (in.2)	.64	1.68	2.72	2.36	6.38	5.67	10.84	9.74	24.64	42.79
Trace Area (in.2 each)	.10	.16	.35	.22	.98	.61	1.86	1.07	2.85	5.12
Metal Area (in.2)	.65	1.03	1.39	1.46	2.28	2.46	3.24	3.53	7.05	10.60
Weight (lb/ft)	.77	1.22	1.66	1.72	2.71	2.89	3.85	4.16	8.38	12.60
*Min. Bend Radii (in.)	5	8	101/2	10%	17	17	24	24	36	48
Wetted Perimeter (in.)				CHANGE STORY		1537530000		Charles (10)		
Product	3.35	4.92	6.31	6.28	9.68	9.65	12.72	13.02	18.63	24.75
Trace (each)	1.49	1.71	2.40	1.87	4.13	3.22	5.32	4.23	6.75	9.63
Fitting Weights (lb)								A CONTRACT		
Trace-Caps	.102	.126	.240	.13	:464	.40	.674	.55	1.67	2.92
Elbows	.706	1.347	2.111	2.65	5.244	6.59	9.649	11.68	27.76	52.51
Impingement Plates	.024	.039	.057		.101	" STATE OF THE STA	.162	141 . 1	.22	.34
Stub Ends	1			.65	1	1.50		2.13		
Terminal Casting			4	.50		1.12		1.75		
	1-2 i	n.	11/2-21/2 in.		2-3 in.	3-4 in		4-6 in.	6	-8 in.
Adapter Flanges	2.41	9	3.816		4.774	7.216		11.106		9.23

(Note: UNITRACE values are indicated in clear areas in the table above. DUOTRACE values are shown in the shaded areas.) *Unitrace may be bent in any direction to these radii provided reasonable tooling is employed.

and Tracing in One Unit 20 514 Alcoa Duotrace Technical Report 10270 Alcoa Utilitube 10460 Process Industries Applications of Alcoa Aluminum	0849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres	in the Process Industries 19416 Brazing Alcoa Aluminum 19415 Welding Alcoa Aluminum 19051 Alcoa Aluminum Handbook
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Unique slag handling conveyor system utilizes 334 Barber-Greene ball bearing idlers, not one of which has yet been re-

placed. Photo shows slag being reclaimed from stockpile and loaded into travelling hopper-feeder.

"MOVING SIZZLING SLAG OVER BELTS

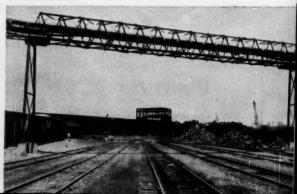
Slag is dumped from ladle cars at 2000°F., sprayed with water, and cooled five days before being transferred to stockpile by clamshell.

Entire 924' two-unit slag handling system was engineered, fabricated, and erected by Barber-Greene, assuring the customer of undivided responsibility for satisfactory performance.





Standard Barber-Greene gallery truss is used to span six railroad tracks in one hop. Remaining tracks are spanned by standard 42" deep truss.





Inclined conveyor utilizes standard Barber-Greene 6" channel frame at tail end for most efficient loading height and 24" heavy-

duty truss on incline to give longer spans between supports.

CUTS HAULAGE COST AT LEAST 40%"

"Our Barber-Greene belt conveyors have performed wonderfully, handling up to 28,000 tons monthly," reports W. R. Moore, Jr., Cleveland Slag official

Lowest cost and most dependable haulage are dual benefits the Cleveland Slag Division of Standard Slag Co. gets with its heavy-duty two-unit 924' long Barber-Greene belt conveyor system that moves slag from stockpile to the crushing plant of this Cleveland aggregate producer.

W. R. Moore, Jr., assistant general manager, relates, "Our Barber-Greene system has performed wonderfully in handling up to 28,000 tons of 200-300°F. slag monthly since installation in 1957. Initially, the conveyors cost about the same as trucks, which were also under consideration. However, our studies have shown that the belts cut haulage cost at least 40% over what it would have been with trucks."

Flow Pattern—Molten slag is received here in ladle cars from nearby Jones & Laughlin furnaces and dumped into cooling pits, where it is sprayed with water before being moved by clamshell to the stockpile alongside the conveyor. A second clamshell then loads the slag into a mobile hopper-feeder mounted over the 556' long inclined conveyor.

Atop the incline, the slag is transferred to a 365' long conveyor that speeds it across the railroad tracks and into the crushing plant, where it is reduced to lightweight building aggregates.

Hopper-Feeder Moves 407'—One of the unique design features of this installation is the Barber-Greene self-propelled hopper-feeder that straddles the horizontal portion of the inclined conveyor. Its 407' travel length permits building of a long stockpile beside the conveyor that can be easily reclaimed with minimum crane movement.

The same engineering skill that solved this tough problem for Cleveland Slag is ready to go to work for you. Your Barber-Greene conveyor specialist will gladly explain how standardized components, specially engineered components, or a combination of both can bring increased efficiency and lower costs to your job.

Barber-Greene hopper-feeder, designed especially for this job, travels 407' along stockpile under own power.



Your belt conveyor equipment headquarters

lepresentatives in Principal Cities of the World

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ASPHALT PAVING EQUIPMENT

WHICH PENTON* PIPE

SOLID PENTON PIPE:

A rigid, uniform pipe produced by extrusion, and available in sizes from ½" to 2" in either Schedule 40 or Schedule 80, in lengths up to 20 feet. Use in conjunction with injection molded, solid Penton fittings with socket or threaded connections (see diagram below). Provides both interior and exterior high temperature corrosion control. Today's most versatile, all-plastic pipe.



COMPLETE CORROSION CONTROL

Inside and outside

High temperature resistance to a broad range
of chemical reagents

Easily fabricated

Resistant to chemical atmospheres

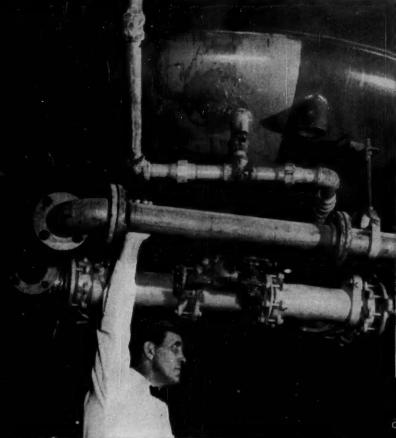
This 1" Penton pipe at Halby Chemical Company, Wilmington, Delaware, carries thyoglycolic acid and ether, has withstood steam-cleaning and outdoor exposure for more than nine months of service. The plastic pipe previously in use failed quickly from steam-cleaning and summer heat.

Penton pipe and solid Penton fittings by Tube Turns, Louisville, Kentucky.

Penton pipe and fittings, used in combination with other readily available Penton components for chemical processing, now make it possible to design a complete anti-corrosion system based on this versatile high temperature thermoplastic. Write for your copy of "The ABC's of Penton for Corrosion Resistance," which rates Penton's performance when ex-

^{*}Hercules trademark for chlorinated polyether

IS BEST FOR YOU?



LINED PENTON PIPE:

Steel pipe with a heavy Penton lining, available in sizes from 1" to 6" I.P.S. outside diameter, in lengths up to 10 feet. Joined by flanged gasket connection (see diagram below), it can be cut and fitted in the field without difficulty. Combines the outstanding high temperature, corrosion resistance of Penton with the structural strength of steel.

This 3" Penton-lined pipe carries a chlorinated product in carbon tetrachloride, 0.1% to 3% hydrogen chloride, less than 0.1% chlorine, and occasional saturation with water, at temperatures ranging from 165° F. to 185° F. It shows no change after more than 10 months in continuous use.

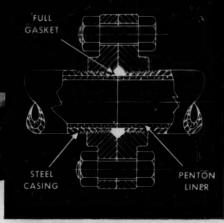
Penton-lined pipe by Saran Lined Pipe Company, Ferndale, Michigan.

posed to over 280 different chemicals and chemical reagents. Complete information on current sources for Penton products is listed in "The Penton Buyer's Guide," also available upon request.

Cellulose Products Department

HERCULES POWDER COMPANY

Wilmington 99, Delaware



THE STRENGTH OF STEEL

and the properties of Penton

Excellent corrosion resistance at elevated temperatures

Economically installed

Safe, durable, and strong

WESTINGHOUSE PROGRE



WESTINGHOUSE PROGRESSIVE AUTOMATION CAN HELP YOU ACHIEVE PLANT FLEXIBILITY, INCREASED POWER EFFICIENCY, ACCURATE PROCESS CONTROL

Rapid changes in chemical processing techniques represent the major problem confronting the industry. How to optimize profits from the present plant investment? How to utilize existing facilities when newer production processes are developed?

Westinghouse is ready to help you plan economical steps to automatic production, to achieve your goals without over- or under-automating. Westinghouse Progressive Automation is an individualized plan to gain higher product quality through step-by-step control of operations... a long-term plan with minimum capitalization.

The dynamic growth of the entire chemical industry finds many electrical systems badly overloaded without adequate protection . . . and narrowly limited to adaptability to changing electrical needs. Powering-Up with an adequate electrical system is a logical first step (on the road to fully automatic production) recommended by Westinghouse.

 To help the industry provide more efficient means of supplying the large blocks of direct current, Westinghouse developed the silicon rectifier for all voltages. Compared to other types of rectifiers, the high efficiency of Westinghouse silicon rectifiers permits power savings of \$50,000 in a typical installation rated 100,000 amps, 300 volts d-c.

Chemical plants have found almost 100% reliability in their control panels with the addition of the Westing-

house Cypak[®] . . . static switching unit which provides extremely reliable process control tailored to meet your existing and growing needs for automatic operations.

Combining groups of control loops is already being investigated in experimental chemical plant installations. This advanced stage of automatic production utilizes data logging and digital computers.

Before maximum automation is practical in the chemical industry, two steps must be accomplished: more direct measurement of variables, and development of additional process data.

Additional Westinghouse experience to guide you in automating your plant was gained in production of $Prodac^*$... first applied to automatic steel-mill rolling. Opcon,* an associated development, experimentally controls process variables to select the *optimum* operating conditions,

And when widely separated functions are ready for central control, look to Westinghouse for experience and equipment for industrial communication and control through multiplex telemetering and microwave transmission.

Today, and for the first time, there is *one* source for control and computer systems and all basic electrical equipment for the chemical industry. Call your local Westinghouse representative for complete information on PROGRESSIVE AUTOMATION.

J-96146-R

*Trade-Marks

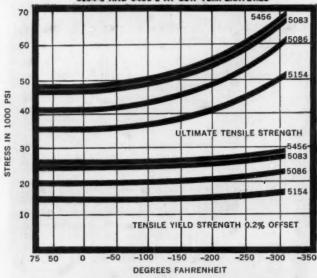
YOU CAN BE SURE ... IF IT'S Westinghouse

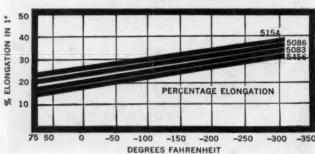
TUNE IN WESTINGHOUSE-CBS TY-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

Why Aluminum for Low Temperature Equipment?

- when temperatures go down, aluminum's strength goes up
- aluminum is light in weight
- · aluminum is easy to fabricate

TENSILE PROPERTIES OF ALUMINUM ALLOYS 5083-0, 5086-0, 5154-0 AND 5456-0 AT LOW TEMPERATURES





In the strange world of minus 250°F and below, materials often take on new and different properties—a fact which demands special design consideration for low temperature equipment.

And more and more frequently, designers are finding that aluminum, better than any other material, meets the mechanical, thermal and economic requirements for these "cryogenic" jobs.

For example, low carbon steels lose so much impact strength at low temperatures that they can't usually be considered. Nickel-alloy steels have better strength than low carbon steels, but in many cases are more expensive to fabricate than aluminum. Aluminum is one of the lowest-cost metals that retains or improves its impact strength at low temperatures.

LOW TEMPERATURE STRENGTH

Aluminum's properties change at sub-sub-zero temperatures, just as all metals do, but the change is for the better. The yield strength, tensile strength and percentage elongation of aluminum all *improve* as temperatures approach absolute zero. This is not true of all metals: Ferritic steels become brittle at low temperatures; the mechanical properties of stainless steel are improved, but it is costly when compared to aluminum.

INCREASING ALUMINUM USES

Largely because of its excellent low-temperature properties and its low cost, Reynolds Aluminum is used in containers, handling and processing equipment for liquefied gases.

Strong lightweight aluminum sheet, plate, pipe, tubing and extrusions are used to handle and process liquefied natural gases, oxygen, nitrogen, hydrogen, helium, and rare gases. Temperatures required to keep these in a liquid state range as low as -452° F, only 8° above absolute zero! Aluminum is the most economical material that can stand up under these extreme conditions.

In addition to its low temperature strength and ductility, aluminum offers other advantages in containers and handling equipment. It is light in weight—one-third the weight of steel—a big benefit in shipping containers and portable equipment.

FABRICATION SAVINGS

Aluminum is easy to handle, easy to join and form. It welds and cuts quickly, often reducing fabricating costs. And it is non-magnetic, non-toxic, and non-sparking, safer to use with volatiles. Finally, aluminum is one of the lowest-cost corrosion resistant materials available.

When you design any equipment for low temperature use, be sure to consider the economics and the low temperature strength of aluminum. For full information on aluminum for low-temperature duty, contact your local Reynolds office, or write Reynolds Metals Company, P.O. Box 2346-CJ, Richmond 18, Virginia.

REYNOLDS ALUMINUM



Watch Reynolds TV Shows: "Bourbon Street Beat" and "Adventures in Paradise"; and, resuming in October, "All Star Golf"—ABC-TV



Ship designed to carry liquefied methane (at -260°F) to England. Liquid is kept in 6,000-barrel tanks made with Reynolds Aluminum plate, the one economical material with improved strength at low temperatures. Aluminum is also used in piping and processing equipment.



Aluminum welds quickly and easily by all common welding methods—as in this liquid gas tank fabrication. It also cuts and forms easily, often effecting savings in construction. And it is one of the most economical corrosion-resistant materials.

How General Electric PRODUCT INNOVATION



ADDED

QUALITY CONTROL

Quality control influences every G.E. operation, from order receipt to shipment.

PRODUCT INNOVATION

Product research and development is advanced in all 98 G.E. laboratories.

APPLICATION ENGINEERING

Customer-oriented application engineers assist you with systems integration.

ANALYTICAL ENGINEERING

The latest tools of process analysis are available for studies of your problems.

INSTALLATION AND SERVICE ENGINEERING

Expert on-site assistance gives you smoother installation and earlier start-up.

SYSTEM CO-ORDINATION

G.E.'s systems experience focuses the full Company capabilities on your order.

NATION-WIDE SERVICE SHOPS

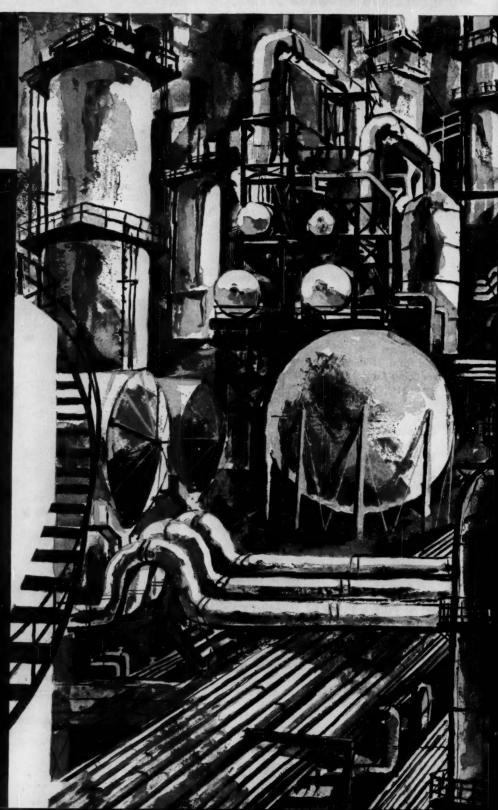
More than 50 G.E. Service Shops offer you 'round-theclock maintenance service.

PROMPT DELIVERY

Accurate delivery cycles put your new G.E. equipment to work for you—on time.

VALUE ANALYSIS

Value Analysis gives you optimum combination of product value and economy.



helps give the petroleum and chemical industries PROCESS FLEXIBILITY

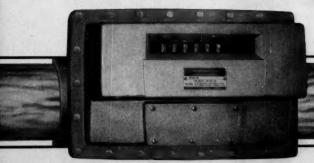
Recognizing your urgent needs for flexibility to meet fast-changing process requirements, General Electric is constantly developing more versatile products. General Electric investment in research and development, currently more than three times as much per sales dollar as the average for all industry, keeps G-E product versatility in step with your process requirements.

AN EXAMPLE OF GENERAL ELECTRIC PRODUCT INNOVATION is the new gyro-integrating true mass flowmeter. This versatile instrument continuously, accurately, and directly measures, in pounds, fluid streams over wide fluctuations in flow rate, density, pressure, temperature, and viscosity. The mass flowmeter eliminates the time-consuming—and sometimes erroneous—conversion of volume to weight. And one basic meter accurately measures a great number of industrial liquids and gases.

FOR MORE INFORMATION on G.E. product innovations that give your processes additional flexibility, call your local General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

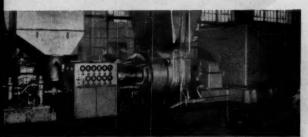




NEW GENERAL ELECTRIC true mass flowmeter handles many different process measurements:

LIQUEFIED GASES . INDUSTRIAL LIQUIDS

NATURAL GAS . REFINERY GAS . INDUSTRIAL GAS



INDUSTRIAL GAS TURBINES, pioneered by General Electric in 1948, are continually being improved for simultaneous double duty: reliable shaft power and economical heat for process hot air or steam.



NEW CUSTOM '8000'* a-c motors are guarded against damage from moisture and chemicals by special Polyseal* insulation systems.

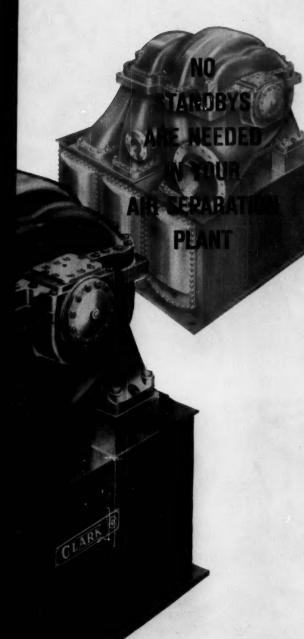
*Trade-mark of General Electric Company



synchronous motors with new and improved insulation systems operate reliably under many process conditions.

CLARK Centrifugal Compressors Assure 100%

Assure 100% **Availability** Typical Clark Isotemp Compressor installation with synchronous motor drive and gear located on mezzanine level.



In air separation plants throughout the world, Clark Horizontally-Split Centrifugal Oxygen Compressors are operating in 100% service. Because the Type HS Compressors are

literally maintenance free, standby units have not been required. The performance of these machines has been outstanding with safety, dependability and efficiency being among the features "best liked" by operators.

Now, another centrifugal compressor has been added to the Clark line of air separation compressors. The new Clark Isotemp Centrifugal Air Compressor has been designed to provide highest purity, primary 110 psi. air for tonnage oxygen plants. Like the Type HS Oxygen Compressors, the *Isotemp* is designed for 100% availability. It incorporates many of the design features found to be so effective in the oxygen machines.

A key feature of the Clark Isotemp Compressor is the system of integral intercoolers. Built into the base of machine, they form a compact unit-engineered package. An unusually high efficiency over a wide operating range is produced by intercooling between stages, the use of closed-type impellers and volute diffusers. Single-case, horizontally-split design assures maximum accessibility and eliminates alignment problems.

If you need high purity compressed air in large volumes, the Clark *Isotemp* will provide substantial savings in capital investment, space, foundation requirements, maintenance and operating costs. The *Isotemp* is built in seven frame sizes in packages with capacities ranging from 5000 to 50,000 cfm and more. Clark Oxygen Compressors are available in matching frame sizes. Both the Isotemp and Type HS units can be driven by synchronous motors, induction motors or turbines.

For data on Clark Centrifugal Compressors and Reciprocating Compressors consult your nearest Clark representative or write for Bulletin 175 on Isotemp Compressors, Bulletin 150 on Centrifugal Oxygen Compressors or Bulletin 160 on Clark Reciprocating Process Compressors.

CLARK BROS. CO.

OLEAN, N.Y.

ENGINES COMPRESSORS GAS TURBINES





CORROSION meets its match in Alcoa aluminum conduit

Here's an electrical rigid conduit that you can install and forget.

Alcoa aluminum conduit solves most corrosion problems in and around chemical plants.

Aluminum protects itself Unlike other conduits, which require some kind of coating, aluminum forms its own protective film. This film forms naturally in the atmosphere and in the presence of oxidizing agents. Damaged spots are self-repairing—almost instantly! The natural oxide coating on aluminum takes the place of factory coatings on conventional conduits and only under unusual conditions is any other protection required.

Other advantages Corrosion resistance is just one good reason for selecting aluminum conduit. Its light weight (about ½ as much as steel) makes it easier to handle and install. Alcoa aluminum conduit is also nonmagnetic and nonsparking.

How about cost? Consider initial cost, savings in installation and mainte-

nance, and service life. You'll see that Alcoa aluminum electrical rigid conduit stacks up as a sound investment.

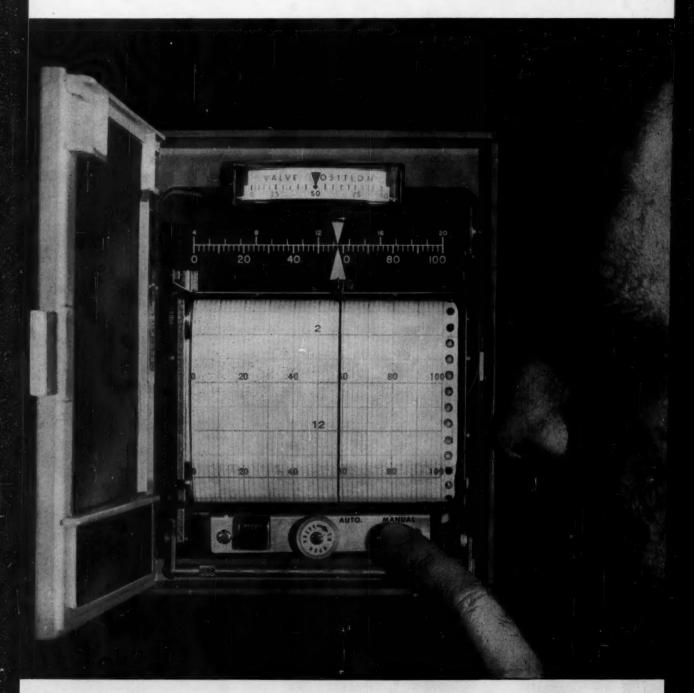
More information For specifications, or answers to specific questions about the use of aluminum conduit in corrosive environments, contact one of our nearby representatives. Or write to Rome Cable Division of Alcoa, Dept. 22-70, Rome, New York.

ROME CABLE DIVISION OF ALCOA



NO CORROSION despite moisture, chemicals and vapors in the basement of this sewage disposal plant in Cleveland. Installed in 1932, this Alcoa conduit still looks almost like new.

New Electrik Tel-O-Set.. needs in a single compact



everything an operator control station



This Honeywell electric control station meets all of your requirements for operator convenience.

One compact case houses every function the operator needs to supervise a control loop: indication of process variable and set point on the same scale; the controls needed to switch from automatic to manual; controls for manual control; and indication of valve position.

The *Electrik Tel-O-Set* control station assures easier bumpless transfer than ever before available because there's no need to "line up" or "match" pointers. A null balance indicator eliminates guesswork,

and the transfer doesn't have to be hurried since the valve remains under control during the transfer.

You can also order the controller with the proportional band, rate, and reset adjustments on the front of the panel conveniently located below the control station, or at the rear of the panel.

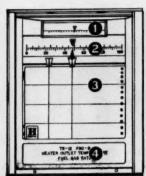
These are just a few of the features that make the new *ElectriK Tel-O-Set* control system an outstanding value. Your Honeywell engineer can give you complete details. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Fall River, Massachusetts.

PIONEERING THE FUTURE

Honeywell



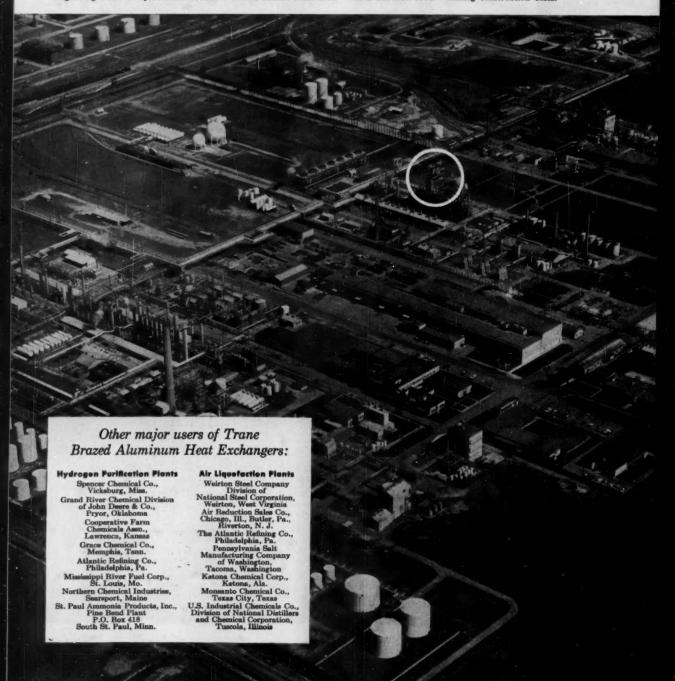


- Valve position indicator continuously indicates controller output when on automatic control.
- Set point index is conveniently located on same scale as process-variable pointer; you can see from a distance any deviation of variable from set point.
- Rectilinear 4-inch calibrated chart is easy to read. At standard chart speed, four hours of recording is always visible. Unit has daily chart tear off or 30-day rewind. Both recorder and control station take the same 5½" x 6" panel cutout.
- You get bumpless switching from automatic to manual control because you don't have to match pointers. In the balance position, the valve position indicator is part of a null circuit that compares controller output and manual output. When indicator reads 50%, both outputs are perfectly matched.

Lower structural, installation Trane Brazed Aluminum

Air view of Shell Chemical Corporation's Houston, Texas, plant. Lightweight and compact construction of Tranz Brazed Aluminum

Heat Exchangers made it possible to install condensing unit on top of a 140-foot tower—cutting construction costs.



and piping costs with Heat Exchangers!

Lightweight aluminum surface made it possible to install heat exchanger on top of 140-foot tower

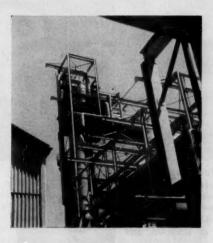
This Shell Chemical Corporation plant near Houston, Texas, has used Trane Heat Exchange equipment for over two years in the production of ethylene. And, Shell reports, the Trane Heat Exchanger is functioning exactly as specified . . . operating at temperatures down to -185° F, with extremely close temperature approaches.

An outstanding feature of the installation is the location of the unit: it was erected on top of a 140-foot tower to reduce piping costs and to meet thermodynamic specifications. This type of installation was possible because of the very lightweight and compact construction of the Trane Heat Exchanger. And it resulted in lower installation costs, savings in valuable ground space. Shell is achieving lower operating costs, too,

because of lower heat losses and extremely close temperature approaches.

This light and compact—yet rugged—heat exchange surface is being used in more and more installations where superior performance is essential. And TRANE Brazed Aluminum Heat Exchangers reduce erection and space costs, too, because a typical TRANE unit requires only half as much space as conventional heat transfer equipment!

If you're interested in reduced refrigeration costs, close temperature approaches, trouble-free operation, design with Trane Brazed Aluminum Heat Exchangers. Thirty years of specialized heat transfer experience is at your service! Ask your nearby Trane Sales Office for complete information. Or write Trane, La Crosse, Wisconsin.



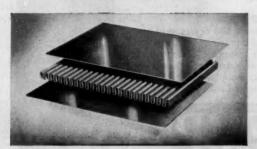
3-stream exchanger condenses a hydrocarbon gas mixture by refrigeration from two colder gases. Operating temperatures are as low as -185° F. Design pressure is 645 psig.

For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. + SCRANTON MFG, DIV., SCRANTON, PA.
CLARKSYILLE, MFS, DIV., CLARKSVILLE, TENN. + TRANE COMPANY OF CAMADA,
LIMITED, TORONTO + 100 U.S. AND 19 CANADIAN OFFICES



Lightweight, compact, rugged! TRANE Brazed Aluminum surface consists of corrugated aluminum sheets brazed together to form a stack of layers that provide individual passages for the flow of gases or liquids. Provides up to nine times the surface per square foot of shell-and-tube exchangers!



Headered for 5-stream eperation, this TRANE Brazed Aluminum Heat Exchanger can handle as many as five fluids simultaneously. Units are available for either cross-flow or counter-flow operation. Surface can be fabricated in a wide variety of shapes and sizes to meet all types of specifications.

KEMP ORIAD DESICCANT DRYERS

cut costs, add efficiency 4 ways!

Complete reactivation

An exclusive 3-zone embedded heater design gives every Kemp Oriad Desiccant Dryer extra drying power economically (effective distribution of heating elements assures high heat transfer efficiency). The most complete reactivation results...providing maximum desiccant capacity, minimum dewpoint performance.

2 Full automatic operation

Set the program timer and everything is regulated automatically. Gases are dried with the least pressure loss, lowest maintenance and operating costs. Your choice of manual or semi-automatic systems, too.

It always pays to come to

3 Accurate temperature control

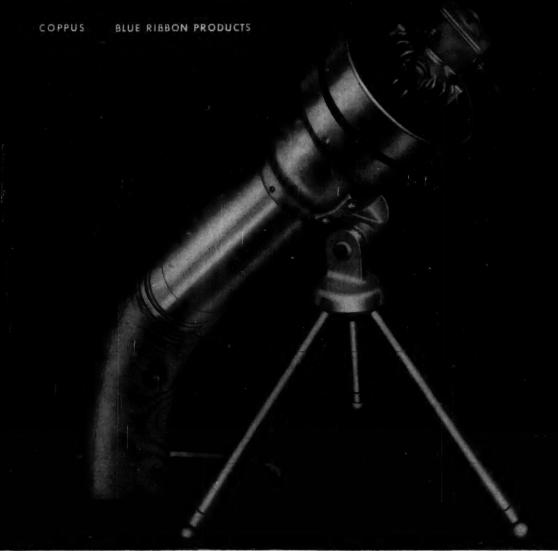
Thermostatic control conserves heat input... maintains ideal temperatures for highest operating efficiency in drying instrument air, process air and gases to the lowest dew point, eliminating condensation or freeze-up, and other applications.

4 No moving parts

There are no blowers, fans or motors to create maintenance problems, rising operating costs. Unit comes fully assembled, ready to install and operate. Write today for Bulletin D-103, or contact your Kemp man, listed in the Chemical Engineering Catalog.

KEMP OF BALTIMORE

THE C. M. KEMP
MANUFACTURING COMPANY
405 E. Oliver St., Baltimore 2, Md.



Coppus Vano® Ventilator

DON'T LET BAD AIR SLOW UP PRODUCTION! Improve your men's efficiency, safety, health and comfort. Get rid of dangerous gases, fumes and stagnant air with a COPPUS "Blue Ribbon" Vano Ventilator. This ventilator brings fresh air to men in confined places . . . acts as both a safety device and a production tool. To keep your men's efficiency and morale high, feed them better air.

There's a portable, easily adaptable Coppus "Blue Ribbon" Ventilator to fit your specific "fresh-air" requirements. The Coppus "Blue Ribbon" is your assurance of sound workmanship and trouble-free, long lasting operation . . . at reasonable cost. Sales Offices in Thomas' Register. Other "Blue Ribbon" Products in Chemical Engineering Catalog, Refinery Catalog and Best's Safety Directory.

			AVENUE, WORCESTER 10, MASS.
For Men Working: in tanks, tank cars, drums, etc.	For Cooling: general man cooling	For Exhausting:	Name
in underground manholes	motors, generators, switchboards	noxious fumes	Address
on boiler repair jobs in aeroplane fuselages, wings, etc.		fumes from reactors, tanks, etc.	ACOPPIE
	ventilating problems yo		COPPUS
	***************************************		BLOWERS



News from

National Carbon Company

Division of Union Carbide Corporation - 270 Park Avenue, New York 17, New York in Canada: Union Carbide Canada Limited, Toronto

Manager Activated Carbon

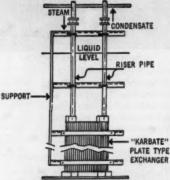


H. B. Allport

Mr. Allport was graduated from Case Institute of Technology with a B.S. in Chemical Engineering. He joined National Carbon Company in 1943. Much of his early work in the Chemical Products Group was devoted to designing and improving existing designs of "Karbate" impervious graphite equipment for use in the Chemical Process Industry.

From 1947 to 1950 Mr. Allport was a district engineer in National Carbon Company's Pittsburgh Sales Office. In 1956 he was appointed Manager, Activated Carbon, Chemical Products Marketing.

"Karbate" Plate Heater Installation Reduces Process Cycle by five hours.



Eight "Karbate" impervious graphite plate heaters are used by a plant turning out phospho-organic intermediates for pesticides manufacture. These units (which replaced eight alloy units) are handling a mixture of phosphoric and hydrochloric acid plus organic materials.

With the installation of eight "Karbate"

With the installation of eight "Karbate" impervious graphite plate heaters the user was able to reduce the production cycle in this application from 19 to 14 hours. It is expected that a modification of the steam piping arrangement will make further savings possible.

"KARBATE" IMPERVIOUS GRAPHITE HEAT EXCHANGERS COMBINE LONG LIFE, CORROSION RESISTANCE AND LOW MAINTENANCE

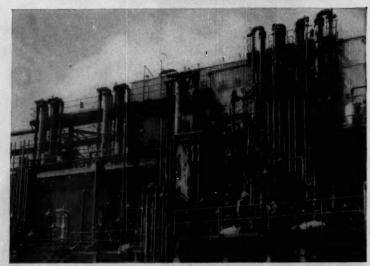


Photo shows a series of "Karbate" shell and tube heat exchangers condensing acid — containing vapors in an organic chemicals plant.

LONG LIFE — "Karbate" Condensers Last 5½ Years Longer Than Metal Units in a Tough Corrosive Service.

The unsurpassed corrosion resistance of "Karbate" impervious graphite makes it an excellent material of construction for shell and tube condensers handling corrosives on both sides. In this service, propylene dichloride with traces of HCl was condensed on the shell side using sea water as the coolant on the tube side.

The condensers have been operating for six years with little maintenance. Metal units in the same service have to be re-tubed about every six months because of excessive corrosion on the active condensing surfaces.

CORROSION RESISTANCE—One "Karbate" Exchanger Does the Work of Two Metal Units

The absence of corrosion products enabled a single 1,290 square foot "Karbate" impervious graphite exchanger to handle the same heat transfer as two steel units each of equivalent area. After one year in a brine cooling application, the steel units accumulated excessive amounts of rust and mud which impaired their heat transfer. Inspection of the "Karbate" impervious graphite unit after a similar time, showed the tubes to be "clean as a whistle" on both sides.

LOW MAINTENANCE — Ten Years of Trouble-free Service Concentrating H₃PO₄.

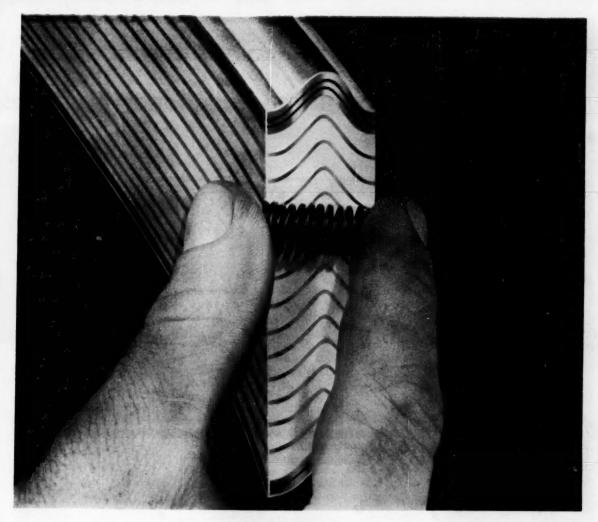
Two 110-tube heat exchangers show the low maintenance advantages of "Karbate" impervious graphite material. These units have provided ten years of service concentrating phosphoric acid from 20% to 75%.

Outside of an occasional cleaning, the user says, these units have required little maintenance over this ten year period.



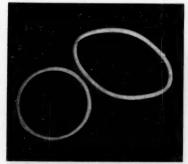
"National", "Karbate", "N" and Shield Device and "Union Carbide" are registered trade-marks of Union Carbide Corporation.





"Spring Action" gives you a leakproof seal with J-M spirotallic® gaskets

Johns-Manville makes a specialty of building a lively "spring action" into Spirotallic Gaskets. Because of their superior resiliency, Spirotallic Gaskets can compensate for varying stresses and temperature changes



Oval and round shapes spirally wound

... follow minor flange separation ... and absorb vibration. Even under these difficult circumstances, they keep a tight, durable seal.

This quick adaptability has given Spirotallic Gaskets a tremendous popularity in the field. Their springiness is due to the special methods and control J-M uses in their manufacture. Spring-like metal strips, formed into a special vee shape, are alternately spiral-wound with an as-bestos filler. The filler does the sealing . . . and the vee shape provides the "spring."

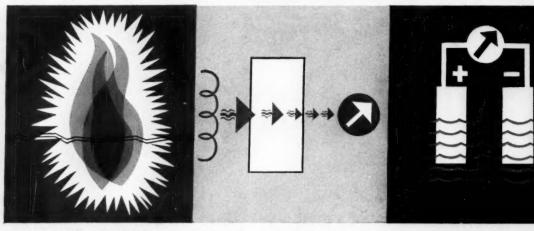
Another reason for the widespread acceptance of Spirotallic Gaskets is the fact that when the gasket has been compressed the proper amount, it reaches optimum performance for the bolting. Many different metals and fillers can be used. Each metal is color-coded to aid maintenance personnel in quick identification of the type of metal

J-M produces a wide variety of sizes and shapes for standard flanges. And for special flanges, J-M will design and produce a gasket with the precise characteristics you require. For complete information, ask for J-M catalog PK-35A. Write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE JM



MSA Instruments apply all these principles



Catalytic Combustion

Infrared Analysis: Now MSA bridges another important instrument gap. The bridge is a simplified low-cost infrared analyzer. One that substantially reduces the size, complexity and high cost of most available instruments.

The new M-S-A® LIRA® Model 300 IR Analyzer has the inherent reliability and accuracy of earlier MSA analyzers. But it's for use in applications where extreme sensitivity isn't so essential. Lets you analyze gases, vapors and liquids faster, more economically.

Weight: only 40 pounds. Size: a trim $8'' \times 10\frac{1}{4}'' \times 20''$.

Our techniques and principles involve a number of other interesting instrument concepts. They're reflected in the symbols spanning the pages above.

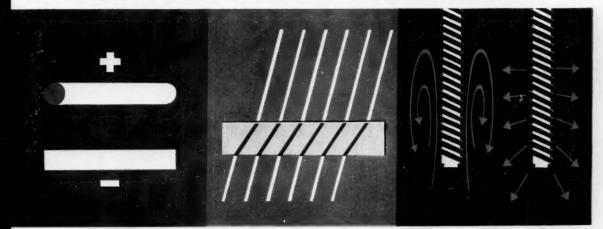
An MSA Instrument Specialist can apply one or more of these principles to your immediate problems. So talk with him about our precision instruments. They're sturdy instruments. And they are reliable.

Write for new M-S-A LIRA Model 300 bulletin or any of our other process stream analyzer literature.



Depolarization

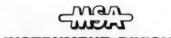
for dependable process stream analysis



Ionization

Refraction

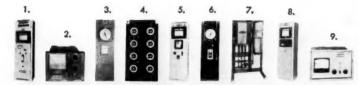
Thermal Properties



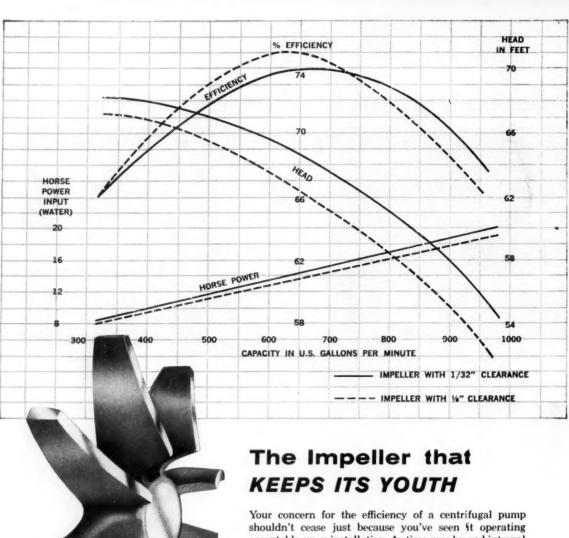
INSTRUMENT DIVISION

Mine Safety Appliances Company

Pittsburgh 8, Pennsylvania



1. M.S.Aº LIRAº Infrared Analyzer Model 200 2. M.S.Aº LIRAº Infrared Analyzer Model 300 3. M.S.Aº Inert Gas Analyzer 4. M.S.Aº Combustible Gas Analyzer 5. M.S.Aº Thermatron Analyzer 6. M.S.Aº Oxygen Indicator 7. M.S.Aº Water Vapor Recorder 8. M.S.Aº BillionAire° Analyzer 9. M.S.Aº Process Refractometer



Your concern for the efficiency of a centrifugal pump shouldn't cease just because you've seen it operating acceptably upon installation. As time goes by and internal clearances are increased by wear and corrosion, will you continue to get the performance you expect?

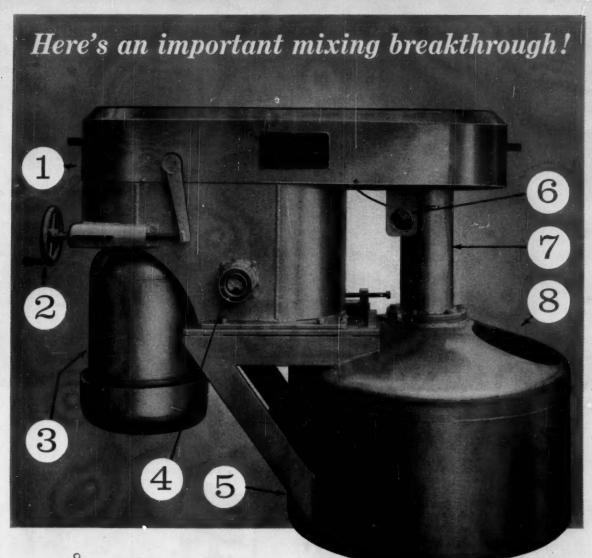
If you've specified a LaBour Type Q or Type SQ, the answer is, "Yes." That's because these pumps use no sealing rings or other critical close-running parts on which efficiency depends.

Compare the two performance curves of a typical LaBour pump with standard initial clearances and the same pump after clearances had been deliberately made four times as great. This is real preservation of youthful vigor—and it's done with an open impeller.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

LABOUR

THE LOBOUR COMPANY, INC. . ELKHART, INDIANA, U.S.A.



NEW COWLES SUPER SERIES DISSOLVERS PROVIDE VARIABLE SPEED, BIG-POWER MIXING IN FIXED TANKS

Now Cowles application engineers have perfected methods of adapting efficient mixing equipment to stationary tanks ... of almost any size, anywhere. If you have such problems they can very likely help you solve them. Here illustrated, for example, is the solution for one prominent chemical processor.

In this case the unit is completely leak proof—sealed against vapor loss in processing. The unique Cowles principle makes this both efficient and practical.

Special services are offered to all engineers in customizing Cowles equipment to fit their particular needs.

All units assure the characteristic advantages of Cowles Dissolvers – big volume in small space...plenty of power for all speeds...self-cleaning, non-clogging impeller...low operating costs.

Consider these features as numbered above— 1-Bridge assembly including MPD* (Maximum Power Delivery) drive system 2-Variable speed adjusting wheel 3-Motor 4-Ammeter, integral with unit 5-Fixed tank 6-Tachometer, integral with unit 17-Vapor-tight housing for stainless steel impeller shaft 8-Vapor-tight closure in tank (Patented stainless steel Cowles impeller in tank, not shown)

*TRADEMARK OF COWLES DISSOLVER COMPANY

Let us prove Cowles advantages - in your plant, at our risk! . Write us today about your problem. No obligation.

MOREHOUSE-COWLES, INC.

1150 SAN FERNANDO ROAD, LOS ANGELES 65, CALIFORNIA

REPRESENTATIVES IN PRINCIPAL CITIES . CONVENIENT LEASE AND TIME-PAYMENT PLANS



Low cost, excellent resistance to corrosion:

FEDERATED CHEMICAL LEAD sheet, pipe, fittings, linings

Federated lead products are self-healing; malleable, easy to form and bend; salvable with high scrap value; and probably the most efficient protection you can find for many corrosive chemical conditions. These products include chemical lead sheets to your requirements; pipe, bends, traps and standard fittings available from stock; special forms fabricated to order. Write for Bulletin No. 162, the Lead Handbook for the Chemical Process Industries, to Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, RE 2-9500; or call your nearest Federated sales office.

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FEDERATED METALS DIVISION

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BIRMINGHAM, ALA. Fairfax 2-1802 BOSTON 16, MASS.

Liberty 2-0797 CHICAGO, ILL. (WHITING) Chicago: Essex 5-5000 Whiting: Whiting 826 CINCINNATI, OHIO Cherry 1-1678 CLEVELAND, OHIO Prospect 1-2175 DALLAS, TEXAS Adams 5-5034 DETROIT 2, MICHIGAN Trinity 1-5040 EL PASO, TEXAS (Asarco Mercantile Co.) 3-1852 HOUSTON 29, TEXAS Orchard 4-7611 LOS ANGELES 23, CALIF. Angelus 8-4291 MILWAUKEE 10, WIS. Hilltop 5-7430 MINNEAPOLIS, MINN. Tuxedo 1-4109 NEWARK, NEW JERSEY Newark: Mitchell 3-0500 New York: Digby 4-9460 PHILADELPHIA 3, PENNA. Locust 7-5129 PITTSBURGH 24, PENNA. Museum 2-2410

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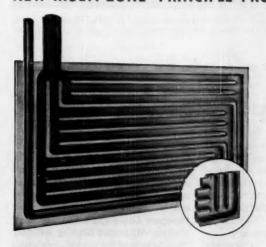
IN CANADA: Federated Metals Canada, Ltd. Toronto, Ont., 1110 Birchmount Rd., Scarborough, Phone: Plymouth 73246

Montreal, P.Q., 1400 Norman St., Lachine, Phone: Melrose 7-3591



PLATECOIL is the versatile, factory fabricated answer to heat transfer problems of all kinds. You can apply PLATECOIL to all types of tank and process heating and cooling — open tanks, closed tanks, agitated tanks, deep tanks, jacketed tanks, sumps, kilns, ovens and many others. Basic PLATECOIL types include header and serpentine designs in single embossed, double embossed, flat, rolled and banked units. They are available in mild steel, stainless steel, Monel, Ni-o-nel, Hastelloy B, Hastelloy C, nickel, and many other metals. Special designs, surface finishes, structural parts and connections add to their versatility. Operating pressure now rated up to 250 psi.

NEW MULTI-ZONE* PRINCIPLE PRODUCES MORE EFFECTIVE HEAT TRANSFER

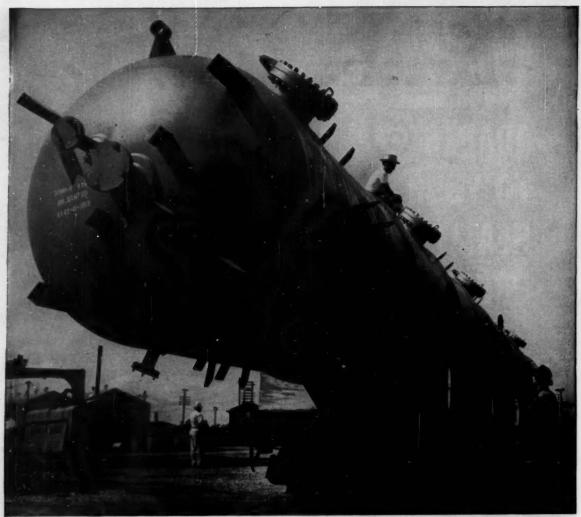


Multiple headers with multiple condensate returns provide better steam distribution and more total effective heat transfer area in the new MULTI-ZONE PLATECOIL. FREE-FLO action, without condensate trapping increases processing production through faster "start-up" and extremely fast temperature recovery. This reserve capacity also holds temperature variations to a minimum. PLATECOIL eliminates problems of engineering, fabricating, installing and maintaining pipe coils. PLATECOIL units are lightweight and easy to handle. They are compact and save tank space. Deposits do not build up on streamlined PLATECOIL surfaces as they do on pipe coils. All stainless steel and alloy PLATECOIL units affected by cold working are annealed and pickled after fabrication to return the metal to its original condition and thus eliminate the probability of corrosion due to internal stresses and carbide precipitation. PLATECOIL is also relatively simple and economical to remove, clean and re-install. In most cases there is no need for threaded joints within the solution to corrode or leak.

Investigate the possibilities of PLATECOIL for your specific problem.

*Patented Send for Bulletin P61 for more data. ranter Manufacturing, Inc.





THIS ENTIRE VESSEL was radiographed. Built for use by Socony Mobil Oil Company, Incorporated, it was stress relieved in thirds,

and the two joints were stress relieved locally. The unit contains 30 uniflex trays of 96" diameter. Overall weight: 152,000 lbs.

Among the largest in use ... built by Newport News

This Debutanizer with a 110 feet 6 inches over-all length is typical of units that are readily built by Newport News...

In fact, Newport News can fabricate almost any type of pressure vessel or other heavy equipment used in the petroleum, chemical or other processing industries.

But at Newport News you'll find

more than large productive capacity.

In vast fabricating shops, in huge machine shops, foundries and forging plants, Newport News craftsmen complete your order with specialized techniques. Plant methods . . . developed as a result of specializing for more than half a century . . . enable Newport News to provide money-saving answers to all sorts

of heavy equipment problems.

Newport News craftsmen handle the job exactly as you want it done ... for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and Products"...it's yours for the asking.

Engineers — Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News

Shipbuilding and Dry Dock Company Newport News, Virginia

BRIEFS

A task for Fluorolube® A better chlorine carrier About lauryl mercaptan



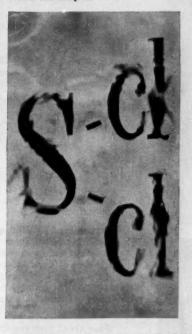
Here, obviously, is a valve that's begging for a shot of lubricant. One that's impervious to oxidants or corrosive liquids. This narrows the field to a very special kind of lubricant: the Fluorolubes (addition polymers of trifluorovinyl chloride).

We use them ourselves on chlorine valves, and find them very good indeed. With old-style lubricants, we had to repack these valves 35 to 50 times a year. With Fluorolube packing, we do it only four or five. Of course the most spectacular uses for Fluorolubes are found in rocketry, where they are applied as coatings and lubricants for parts of missiles in contact with oxygen. They're heat-stable, too. Up to 400° F. We have some literature on Fluorolubes you can get by checking the coupon.

IF YOU WANT REACTIVE CHLORINE ATOMS

A good way to inject chlorine atoms into certain compounds is to use Hooker sulfur dichloride. Examples: chloridizing agent in metallurgy; reagent in manufacture of rubber cements and insecticides; hardener for printing inks.

Since we're in the chlorine business, our background on how to deal with chlorine atoms in usual as well as unusual ways is quite broad. Write us if you have questions—or, if you wish technical information, just check the coupon.





LAURYL MERCAPTAN, A CHEMICAL FOR IDEA MEN

Here is an interesting Hooker product used primarily as a polymerization modifier in the manufacture of "hot type" synthetic rubber. To the imaginative researcher this mercaptan may conjure up some fresh ideas in polymer chemistry. For research samples, please write on your business letterhead. For technical data sheet, check and mail the coupon below.

Typical properties

Analysis:
mercaptan sulfur 14.7-14.8%
chlorine 0.2%
LAST CRYSTAL POINT7°C
BOILING RANGE AT 5 MM
(first drop to 95%) 108-139°C
FLASH POINT 128°C
FIRE POINT 139°C
REFRACTIVE INDEX, N20/D 1.4582
Specific gravity at 15.5°C 0.849

For more information, check here and mail with name, title and company address:

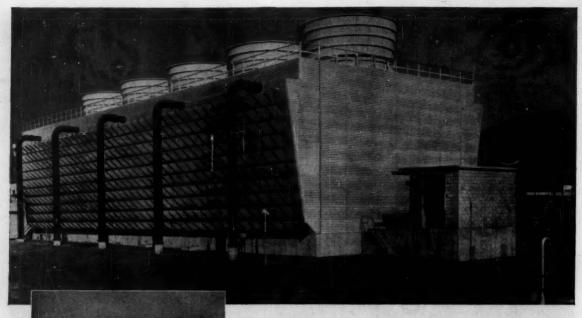
- ☐ Fluorolubes, Data File
- ☐ Sulfur Dichloride, Data Sheet
- ☐ Lauryl Mercaptan, Data Sheet

HOOKER CHEMICAL CORPORATION

407 Farty-seventh Street, Niagara Falls, New York

Sales Offices: Buffalo Chicago Detroit Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass. In Canada: Hooker Chemicals Limited, North Yancouver, B. C.





WAGNER® MOTORS HELP MARLEY TOWER

PRODUCE MORE POWER FOR BURBANK

This is the new Marley Class 600 Double-Flow 5-cell cooling tower at the power station of the City of Burbank, California ... the newest thing in cooling tower design. Its job: to cool water to get more kilowatts from steam.

Wherever water cooling is vital to plant capacity, product quality or customer comfort, chances are you'll find a Marley Cooling Tower. You'll probably find Wagner* Motors there, too. They're on this tower in Burbank, driving the huge fans used in the tower's cells.

The job is a rugged one. It calls for motors that can operate without attention month after month... motors that can stand constant exposure to all kinds of weather and to high humidity, the number one cause of motor failure in cooling tower applications.

Wagner Type EP Motors meet these requirements. All vital parts of these workhorse motors are totally enclosed, and are sealed against moisture by a series of grease retaining grooves between shaft and housing. Running shaft seals, at both ends of the frame, prevent the entrance of water into the bearing housings. The frames, endplates and conduit box are made of heavy cast iron for extra protection against high humidity and corrosion.

What about your requirements for motor drives that must operate under adverse conditions? Versatile Wagner Totally-Enclosed Motors can meet them, whatever the application. They are available in standard ratings through 500 hp. Call your nearby Wagner Sales Engineer for full details, or write for Bulletins MU-224 and MU-230.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wasner Electric Corporation

6407 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WH60-17

At work on the fan deck:

Five Wagner Type EP,

75 hp, 480 volts, 1750

RPM Motors.

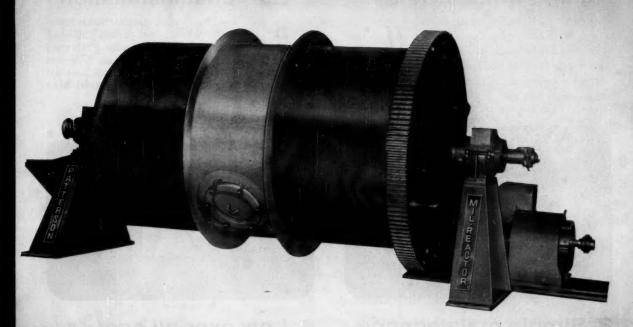
NOW. Reacting. Extracting. Drying...

Grinding...Thermal Reacting...

Blending...Wetting...Dispersing...

in the ALL-IN-ONE

PATTERSON Mil-Reactor



A COMPLETE PROCESS UNIT,

replacing separate reactor, blender, dryer, grinder and solvent extractor, bringing unparalleled savings in first cost, operating cost, space, time and labor!

The Patterson Mil-Reactor provides size reduction with mass transfer or chemical kinetic operations. It provides gas blanketing during solid-solid or liquid solid operations . . . simultaneous addition of liquids, with vapor addition or removal . . . precise control of temperature . . . concurrent or counter-

current liquid-solids flow . . . batch and in many cases continuous operation.

In every operating characteristic, this new processing unit brings hitherto unobtainable efficiency in utilization. It is a tool of tomorrow for the chemical industry, ready for your advanced demands of today. Let us send you the remarkable Mil-Reactor story—and make any desired pilot studies for you in our high temperature test facility. May we have your inquiry?

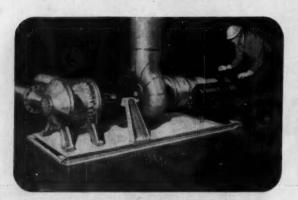
THE Patterson foundry and machine company east liverpool, ohio

You get four major advantages with Solar industrial gas turbines



1. Easily transported

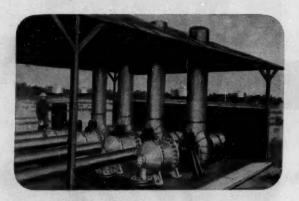
Because they are smaller and lighter than conventional power plants, Solar gas turbines are easily transported for original installation, or to a central shop for periodic maintenance. And the basic power plants, or generator sets, compressor units, and similar applications, can be inexpensively adapted for portable use.



3. Simple maintenance

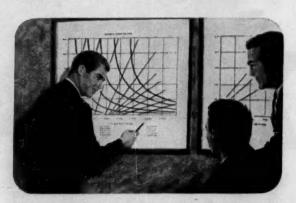
Solar gas turbines are simple in design, with few moving parts. They are easier to maintain than diesel or gasoline engines. Down time is cut to a minimum. Features such as interchangeable compressor wheels in Solar compressor units make quick field changes possible. Solar turbomachinery is designed for long, trouble-free life.





2. Low cost installation

The same light weight and small size that makes transportation simple, also cuts the cost of installing Solar gas turbines and turbomachinery. Minimum vibration makes possible skid mounting or the use of present light foundations—you avoid heavy construction costs and install these units quickly without special labor requirements.



4. Low over-all cost

Whether you consider the capital cost of installed horsepower, or operating and service costs per installed horsepower, you will be pleasantly surprised when you measure Solar gas turbines against competing installations. We'll furnish the facts and figures you need on request. Solar builds turbines and turbomachinery to rugged industrial standards, for electrical power generation, gas compression, pumping, boat and vehicle propulsion, and for many special applications. Solar gas turbines range in size from 50 to 1250 hp.

You should investigate the profitable use of Solar gas turbines and turbomachinery. Write to Solar Aircraft Company, Dept. H-138, San Diego 12, Calif., for brochures or for information about specific applications.

NEW FALK EQUI-POISED MOTOR MOUNT

gives unequaled economies plus convenience

6

HOW A FALK EQUI-POISED MOTOR MOUNT REDUCES BEARING LOADS ON A DRIVEN MACHINE

GIVEN:

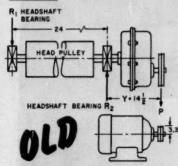
Motor—15 hp, 1750 rpm, Frame 284U, Weight—320 lb. Sheave diameters—6.6/9.4 Driven machine—belt conveyor

with 24" center distance between headshaft bearings.

NOTE:

Weights of 307J24 Shaft Mounted Drive, sheaves, and V-belts are eliminated from calculations because they remain constant; do not affect the comparison.

WITHOUT FALK MOTOR MOUNT



Torque at motor shaft=63,025x15 hp=540 lb-in.

1750 rpm

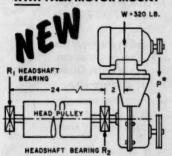
Belt pull (P)=540 lb-in. x 1.5 Load Connection 3.3" Factor =246 lb

R₂=246 lb x (24" + 14.5")=395 lb

R₁=246 lb x 14.5"=149 lb

(Check: 395 lb-149 lb=246 lb)

WITH FALK MOTOR MOUNT



P . ZERO REACTION AT HEADSHAFT BEARINGS

V-belt pull has zero reaction on headshaft bearings. Therefore—

R₃=320 lb x (24" + 2")=347 lb

R₃=320 lb x 2"=27 lb

(Checks 347 lb-27 lb=320 lb)

Falk's new EQUI-POISED* Motor Mount is a

rigid, all-steel weldment, pre-drilled for bolting standard NEMA foot-mounted motor (1/2 to 30 hp) directly to the steel frame of Falk Shaft Mounted, Flange Mounted and Screw Conveyor Drives. With it, motor can be mounted in almost any position around perimeter of reducer.

(*Balancing of forces.)

Substantial Savings for You

It saves engineering time required to design special motor bases and foundations...saves cost of labor and materials required to build special motor foundations...and saves on equipment costs by using a quality stock component. Further, its quick installation and easy maintenance mean added cost savings. The Motor Mount is a space saver, too. Where restricted space is a factor, ability to mount motor in any of several positions is an important convenience...For information on range of sizes, dimensions, etc., contact your Falk Representative or Distributor—or write direct for Bulletin 7100.

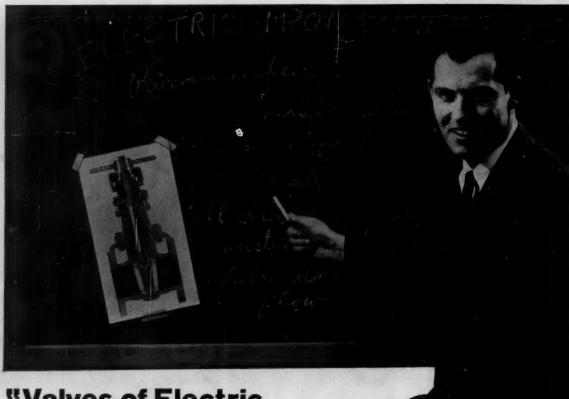
THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS



Representatives and Distributors in most principal cities

FALK is a registered trademark



"Valves of Electric Furnace Iron – an R-P&C specialty"



"Manufacturing castings from iron melted in our own electric furnaces and to our own specifications has long been an R-P&C specialty. Recognized for their superior quality, these castings of highly refined metal are substantially free of impurities. Dense grain structure gives them a high resistance to corrosion, high tensile and transverse strength, plus excellent deflection characteristics. In fact, their physical properties far exceed the standard requirements for iron valve castings. And all of these advantages are available to you in R-P&C Electric Furnace Iron Valves at no extra cost."

Shown here is an R-P&C Gate Valve of the flanged end type. It is available in sizes from 2" to 24" in bronze trim or all-iron construction. The R-P&C Iron Valve line includes other popular types of Gate, Globe, Angle and Swing Check Valves—all made of Electric Furnace Iron.

Contact your R-P&C distributor. He can supply you promptly with any Iron Valve you need as well as gate, globe, angle and check valves in bronze, cast steel and forged steel; all in a wide range of sizes, styles and pressure classes. See him or write...

R-P&C VALVES

R-Pa C Valve Division, American Chain & Cable Company, Inc.
Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York,
Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.



Cracking tough heat exchanger problems is what we do best

For more than 40 years, American-Standard* Industrial Division engineers have specialized in designing and making heat exchange equipment for virtually all conditions and applications. Drawing upon this vast experience, American-Standard Industrial Division can base recommendations upon precedents of proved success. And, in many instances, our comprehensive standardization paves the way for savings in cost and time. Get the full story on American-Standard heat exchangers. Send for Bulletin 0.4A9 today. American-Standard Industrial Division, Detroit 32, Michigan.

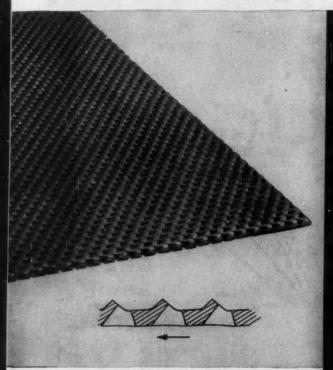
*American-Standard and Standard are trademorks of American Radiator & Standard Sanitary Corporation.



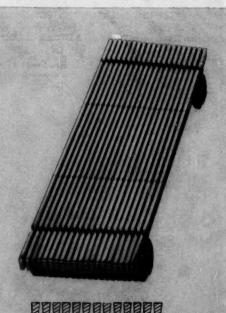
CHEMICAL ENGINEERING—July 25, 1960

from NATIONAL-STANDARD

NEW CONCEPT IN SCREENING



CONIDURE* sheets are available in a complete range of hole sizes and rolled surfaces. The working side of Conidure sheets has shovel-like humps that guide material into the narrow openings, increasing screening action. The extreme taper of the hole prevents clogging or blinding.



RIMA* screens can be supplied as rectangular, oblique angled, round or oval beds. The complete range of slit widths and wire profiles accommodates a wide variety of screening and filtering operations.

New CONIDURE Screens

New Conidure sheets are produced by a unique process of piercing trapezoidal-shaped holes, highly tapered in the screening direction. Sheet thickness can be several times greater than hole diameter for higher capacity and longer wearing life in coal, sugar and chemical centrifuges or on vibrators, separators and screening machines.

*®by Hein, Lehmann & Co., Dusseldorf, Germany

New RIMA Screens

New Rima shaped-wire screens for coal, paper and food processing and water or sewage filtration have special capacity advantages over standard wedge-wire screens because of high-narrow profile wires that provide larger open area. The unique cross bar and spacing lugs keep wires uniformly separated for greater efficiency in screening.

FOR COMPLETE INFORMATION on New Conidure and Rima Screens, write for new illustrated catalog to NATIONAL-STANDARD COMPANY, NILES, MICHIGAN

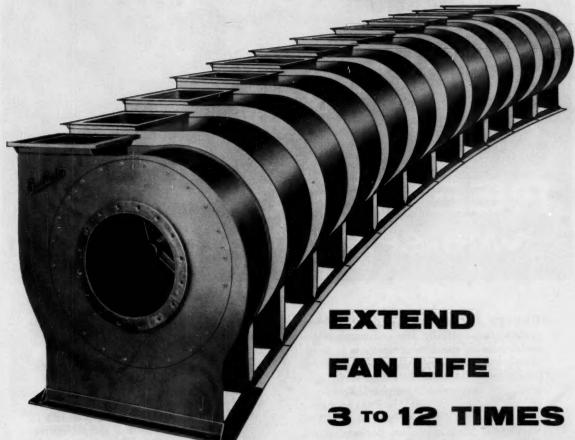


COMPANY	
-	



Cross Perforated Metals
NATIONAL-STANDARD COMPANY
Carbondale, Pa.

ON CORROSIVE JOBS



By "welding" rubber to all metal parts of a fume fan, Buffalo Forge extends fan life 3 to 12 times. Certainly, where you handle highly corrosive fumes, there is no more economical way than with these 'Buffalo' rubberlined fans. The extra cost for the lining is repaid many times in longer service without downtime losses for replacement.

Other Corrosive Applications may not require rubberlined fans. Special coatings, stainless steels and other materials are often adequate for the fumes exhausted. For example, 'Buffalo' builds resin-bonded fiber glass fans which are both corrosion and impact resistant to temperatures up to 225°F.

For Every Condition, you can depend upon Buffalo Forge for effective, efficient and economical answers to your air handling problems.

Write today for Bulletins 2424-F and FI-511, outlining the chemical characteristics, volume and pressures of fumes to be exhausted — or call your nearby 'Buffalo' Engineering Representative.



BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



Equipment to move, heat, cool, dehumidit and clean air and other gases.



'Suffalo' Machine Tools to dril punch, shear, bend, slit, notch and cape for production or plant maintenance.



Buffalo' Centritugal Pumps to handle most liquids and sturries under a variety of conditions.



to process sugar cane, coffee and rice. Special processing machinery for chemicals.



REEVES AIRtrol, in an open or closed loop system, automatically and continuously corrects operating speeds to compensate for variations in materials or processes. AIRtrol controls variable output speeds from temperature, liquid level, pressure, weight, peripheral speed and proportional flow signals. Here are important reasons why REEVES AIRtrol on REEVES Vari-Speed Motodrives, are performing efficiently on conveyors, pumps and machine tools . . . and in process industries handling solids and liquids.

 Exclusive contoured cam design results in output speed in direct proportion to instrument air signal. This permits linear (straight line) output speed over the entire output speed range of the drive.

- Cam also provides a sensitive and stable control throughout the speed range . . . automatically.
- AIRtrol operates on a 3—15 psi. air signal from any standard process-instrument. Exclusive "Span Adjustment" feature makes it possible to use the full signal . . . locking the 3 psi. signal to minimum speed and 15 psi. to maximum speed of the motodrive. This applies to units of 2:1 speed range, as well as 10:1.
- REEVES AIRtrol is available on all REEVES Vari-Speed Motodrives—¼ hp. through 40 hp., 2:1 through 10:1 speed range, with variable output speeds as high as 4660 to as low as 1.71 rpm.

For complete information on REEVES AIRtrol, call your nearest Reliance Sales Engineer.

G-1664

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

RELIANCE ELECTRIC AND ENGINEERING CO.

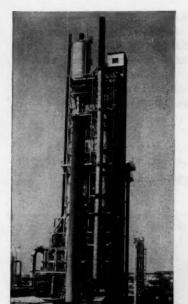
DEPT.137A, CLEVELAND 17, OHIO Canadian Division: Toronto, Ontario Sales Offices and Distributors in Principal Cities



Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V+S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.



Metal raincoats of Armco ALUMINIZED STEEL Type 2 Protect and insulate at low cost



STACKS

Armco Aluminized Steel Type 2 gives economical, durable service in applications such as those shown here because it combines the strength of steel, the surface characteristics of aluminum, and low cost.

Hot-dip coated with aluminum by a patented Armco process, ALUMINIZED STEEL Type 2 has excellent resistance to atmospheric corrosion. This has been proved by 20-year exposure tests, and by satisfactory service in chemical, petroleum and power plant applications. Insulating and heat-saving advantages come from the ability of ALUMINIZED STEEL to reflect a high percentage of incident radiant heat.

No Paint Needed. The strength and rigidity of steel not only make weather shields of this two-in-one metal easier to design and erect, but safer as well. They take high wind loads and are resistant to fire damage. You also get a bonus benefit because the attractive surface of ALUMINIZED STEEL needs no paint.

Many plant engineers specify Armco Aluminized Steel Type 2 as a standard material for weather shielding and insulation jacketing. Try this special aluminum-coated steel for similar applications in your plant. See how its many advantages can be used to cut costs and eliminate troublesome maintenance problems. For complete information on the properties and fabrication of Aluminized Steel Type 2, write Armco Steel Corporation, 2210 Curtis Street, Middletown, Ohio.







DUCTS

REACTORS

ARMCO STEEL



Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

This won't stop corrosionbut versatile-flexible TYGON WILL!

Simply crossing the fingers doesn't help much when it comes to corrosion control. But a sure-fire method—and much more economical in the long run—is to specify Tygon if corrosion is a problem in any product you make. Available in a variety of convenient forms and job-specified formulations, Tygon offers superior resistance to a wide range of acids, alkalies, salts, alcohols, oils and solvents.

CHECK THE WAYS TYGON CAN IMPROVE VALUE AND PERFORMANCE OF YOUR PRODUCT

AS A COATING

Easily applied by brush, spray, dip or roller-coat, Tygon forms a fast-cure, tough, impermeable plastic barrier that seals out corrosive fumes and acids. Gives equipment longer lasting protection against chemical attack and extreme moisture.



AS TUBING OR HOSE

Flexible, glass-clear Tygon Tubing is ideal for piping flavor-sensitive liquid foods or corrosive chemicals. Non-toxic, non-contaminating, sterilizable. Tough, durable, abrasion-resistant for long service life. Available 1/16" to 4" I.D.

AS LININGS

Tygon Sheeting offers heavyduty protection against corrosive solutions in storage and processing tanks of all shapes and sizes. Easier to install, handles many of the tough jobs rubber and other linings cannot do.



AS GASKETING

Tough, resilient Tygon Gasketing assures tight, durable, leak-proof sealing. Its excellent chemical resistance eliminates costly corrosion "trouble spots" where other materials fall. Cut from sheet, tubing, solid cord, or molded to your specifications.



Write for detailed Tygen Pertfolio today—or ask our engineering staff to recommend the proper Tygon formulation for your application. PLASTICS AND SYNTHETICS DIVISION



AKRON 9, OHIO

July 25, 1960—CHEMICAL ENGINEERING

DEVELOPMENTS ...

JULY 25, 1960

Chementator

T. PETER FORBATH

Latest firm to declare itself in natural-synthetic rubber is American Rubber & Chemical. The company, formed specifically for this venture by Stauffer Chemical and American Synthetic Rubber, eyes Sept. 1961 as start-up date for a 30,000-ton/yr. plant in Louisville, Ky., to make polyisoprene and polybutadiene via the Phillips process.

American Maize-Products plans commercial production of starch phosphates at Hammond, Ind., by end of this year. Products, made by process licensed from International Minerals & Chemicals, are aimed at use as thickeners in packaged foods, binders in ore processing, drugs and adhesives.

Diamond Alkali claims it has developed "a unique form of sodium alkali" that can absorb up to 30% its weight in liquids yet remain dry and free-flowing. Material, though unidentified, is believed to be a sodium carbonate product.

Now fluid bed sights on columbium

Fluid-bed processing is out to win still another job in the metal-ore processing field. Latest one is production of columbium via reduction of columbium pentachloride by hydrogen at 1,500 F. in a fluidized bed of columbium seed particles.

Developed by Battelle Memorial Institute, Columbus, Ohio, for Canada's Nova Beaucage Mines, Ltd., new process has been tested in lab, currently is in pilot-plant stage of development. And Nova Beaucage, which owns some 2 million tons of 86% Cb₂O₃ ore reserves near Lake Nipissing, Ont., is optimistic though not specific about its commercial future.

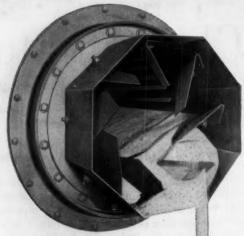
U. S. columbium producers, who've had a look at process via a Battelle paper given at the recent American Institute of Chemical Engineers' meeting in Mexico City, have adopted an "interested, wait and see" attitude on the fluid-bed scheme. If the success of fluid beds in other metal-making jobs can be used as a guidepost, what they may see after waiting is the first continuous route to "premium quality" columbium. For example, Allied Chemical's General Chemical Div. has used fluid beds to transform uranium processing from a batch to a continuous operation at Metropolis, Ill. (Chem. Eng., July 11, p. 70)

Conventional columbium processes involve fluoridation of ore (which usually contains both columbium and tantalum as oxides), liquid-liquid solvent extraction of metal fluorides to separate Cb from Ta, calcining to drive off fluorine and vacuum-furnace reduction of columbium oxide to pure metal. Battelle's process calls for chlorination of ore, separation of tantalum and columbium chlorides by distillation and reduction of columbium pentachloride with hydrogen in fluid bed.

Multiple or single building contracts?

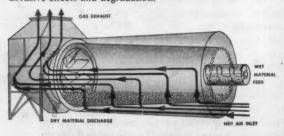
Dow's Texas Div. presented strong arguments last month in favor of multiple-contract

Specify a LINK-BELT Roto-Louvre



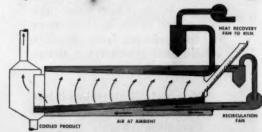
for uniform drying

ROTO-LOUVRE DRYERS provide precise processing for heat-sensitive, friable and hygroscopic materials. Compact and highly effective, the Roto-Louvre introduces dry, heated air through ever-changing channels . . . exposing the entire surface of every particle to uniform treatment. NO OVERHEATING—Large volume of hot, dry air easily penetrates thin bed at feed end for maximum heat transfer where greatest evaporation can take place. At discharge end, smaller air passages permit less heated air to penetrate bed. NO BREAKAGE—Material rolls gently over itself in a spiral path to the discharge end, minimizing abrasive effects and degradation.



for uniform cooling

ROTO-LOUVRE COOLERS use air at ambient temperatural or air at reduced temperature from a cooling unit. No other cooler can turn out a more uniformly cooled product! And because material rolls gently over itself, no degradation occurs from lifting and cascading. This same gentle rolling action also prevents abrasion to the louvres. The Roto-Louvre excels where heat can be used for subsequent processing. Two types of recirculation arrangements are available, depending on desired extent of heat recovery. With the superheat recovery system (below), air can be passed over material a second time . . . permitting heat recoveries up to 60%.



You can lower your per-ton drying and cooling costs with consistent uniformity of end product when you rely on the efficiencies of Link-Belt Roto-Louvre. And, valuable floor space can be saved since Roto-Louvre occupies up to 50% less space than other types of units of similar capacities.

LABORATORY PRETESTING SERVICE! We'll be glad to laboratory-test a sample of your material and work out drying or cooling procedures you can duplicate in your plant. For complete details and Roto-Louvre Book 2511, contact your nearest Link-Belt office.





LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses and District Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney): Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

construction of chemical process plants, as opposed to awarding the entire plant construction job to a single engineering contractor. Forum for expression of these views was annual meeting of the American Assn. of Cost Engineers in Houston.

George McGovney, speaking for Dow, claimed that competitively bid, lump-sum, multiple contracts had netted Dow real savings in time and money since adopting this new approach to plant construction some six years ago. As evidence, he showed charts which compared two periods, 1951-2 vs. 1957-8, during which dollar volume of capital construction was approximately the same. Contractor manpower in latter period was less than half that of earlier period.

In a prepared rebuttal, Fluor's W. I. Mc-Kay cited figures on construction labor productivity which took some of the edge off Mc-Govney's claims. McGovney's base period, coinciding with the Korean War, was one of low productivity, said McKay, and productivity has been improving ever since. As proof: Three Fluor jobs, all in the same geographical area and under the same construction superintendent, showed this trend in unit labor costs: 1955, 100%; 1958, 86%; 1959, 76%.

In Dow's multiple-contract system, Dow engineers retain responsibility for over-all planning and scheduling of the project. In a typical multimillion-dollar project described by McGovney, Dow divided the work into 17 separate contract packages and got competitive lump-sum bids for each job from as many as nine bidders. Total job cost was some 15% under Dow's detailed estimate; construction was completed 3½ months ahead of plan.

Dow has no monopoly, countered McKay, on smart planning and scheduling. He estimated that Dow's plant could have been built by Fluor on a single, firm-price contract in three to six months less time than Dow's actual performance.

Atomic power gets stunning setback

Atomic power has received a stunning setback. And the blow has come from one of the industry's very best friends.

The United Kingdom, pioneer and hitherto major booster of commercial-scale atomic electricity, last month announced that it's slashing its nuclear power program in half. Original program called for a \$2.5-billion investment in 14 atomic power stations to deliver some 6,000 mw. of electricity by 1966. Now the British plan to build only seven A-plants with 3,000 mw. capacity by that date. In order to maintain nuclear technological progress and sustain its nuclear industry, Britain will place orders for atomic stations after 1966 at the rate of one per year. But this will bring the nuclear contribution to the country's electrical grid to only 5,000 mw. by 1968.

Cutback doesn't represent a lessened power need in Britain. Loss in atomic electricity will be replaced by construction of new coal-fired stations. Chief reason for move is one of economics. UK Minister of Economics, Richard Wood, reported to the House of Commons that conventional power costs are about 25% less than nuclear costs at this time. And Sir Christopher Hinton, chairman of country's Central Electricity Generating Board, estimates that replacement of nuclear stations by coal-fired plants under the new program will provide capital savings of about \$260 million.

Though the British believed that atomic power could compete with fossil-fuel power right now, they currently feel that even the most advanced nuclear reactors will not be economical until 1970.

Rocket debate: What structural material

Whatever the outcome (expected in the next few weeks), the current competition between Hercules Powder and Aerojet General for the Air Force contract on the Minuteman missile's third stage provides an almost perfect illustration of the latest great debate to embroil rocketeers. That debate: What makes the best missile material of construction—metals or plastics?

Hercules is backing a glass-fiber-reinforced epoxy, trade-named Spiralloy, that's formed into rocket motor casings by a filament-winding technique invented by company's Young Development Div. Aerojet is convinced that titanium alloy can best handle the construction requirements of the U. S.'s first solid-propelled Intercontinental Ballistic Missile. In an effort to demonstrate the validity of their opposing positions, each firm last month conducted successful test firings of prototype third-stage Minuteman motors fabricated from its own favored material.

Hercules takes its stand primarily on the basis of Spiralloy's high strength-to-weight

(Continued on page 58)

at Wyandotte Chemicals Corporation:

ELECTROLYTIC CAUSTIC SODA PRODUCTION with DORR-OLIVER equipment



Each of the two Dorr Thickeners supplied to Wyandotte Chemicals Corp. is designed to handle 50,000 lbs. per hour of 50% coustic (NaOH) solution at 70° F., containing salt crystals in suspension. Thickened under-

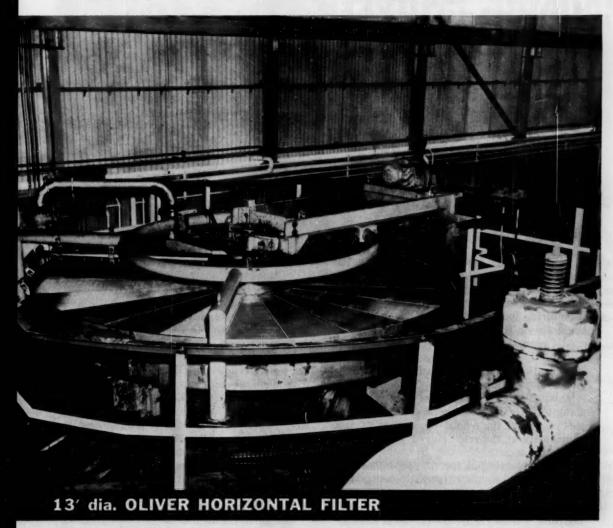
flow, consisting of salt and the caustic solution, averages 60% solids by weight. Overflow is strong caustic, containing essentially no suspended solids. Despite corrosive conditions, maintenance is held at a minimum.

The modern plant established by Wyandotte Chemicals Corporation at Geismar, Louisiana, makes caustic soda and chlorine from brine by the electrolytic process.

Important factors in the flowsheet are a 13' dia. Oliver® Horizontal Filter used to separate salt crystals from a saturated transfer liquor and two 35' dia. Dorr® Thickeners designed to handle a 50% caustic solution containing salt crystals in suspension, the thickened salt underflow being returned to process.

Equipment was specially designed for the corrosive conditions encountered in this application, the filter being of nickel construction. Use of the horizontal type filter makes possible the rapid, continuous filtration required for high volume operation, as well as minimizing maintenance problems.

This installation furnishes an excellent example of the adaptability of Dorr-Oliver equipment for highly specialized operations in the chemical industry. Skilled Dorr-Oliver engineering service, laboratory and pilot plant equipment for precise testing and evaluation, and world-wide experience covering all phases of chemical plant operation, are always at your call. For any application involving sedimentation, clarification, separation or classification, write to Dorr-Oliver Incorporated, Stamford, Connecticut, for information on a complete range of equipment.



This filter separates approximately 40,000 lbs. of sodium chloride crystals per hour from a saturated salt solution with a feed consistency of 25% crystals by weight. Discharged salt has a moisture content of approxi-

mately 5% and is continuously removed by a scroll discharge mechanism. Horizontal filter design utilizes gravity to aid filtration, thus reducing vacuum pump requirements.



ratio. Whereas strength-to-weight ratio of super-strength steel alloys is about 1 million in. and of titanium alloys about 1.1 million in., Spiralloy offers strength-to-weight ratios better than 1.8 million in. Furthermore, Hercules points out, Spiralloy has already been successfully used in a number of space probes including the Vanguard, Tiros, Explorer, Pioneer.

In electing titanium alloy, Aerojet is backing a material that, though much studied, has yet to be named for a rocket job. Nevertheless, the company, which says it investigated and rejected reinforced plastics for the Minuteman application, believes titanium alloy exhibits features not available in any other structural material.

Prime virtue of the metal is that, unlike reinforced plastics, it's a homogeneous material, thus offers uniform and closely controllable properties. Heterogeneous materials, on the other hand, are subject to quality variations within a single piece and from one piece to the next. Too, titanium is stable over long periods and at extreme conditions, doesn't age with resulting degradation of properties as do plastics.

Engineers, technicians seek status

In almost the same breath, the National Society of Professional Engineers, at its annual meeting last month in Boston, took actions designed to enhance the professional prestige of engineering technicians on the one hand and engineers on the other.

It adopted a plan under which engineering technicians soon will be able to obtain formal "certification" in much the same way that engineers now obtain professional licenses. And it submitted a suggested political platform plank to both the Democratic and Republican parties calling for official recognition of the "immensity of the role" played by engineers in modern society.

NSPE has set Jan. 1, 1961, as the date that it expects to establish its Institute for the Certification of Engineering Technicians and Engineering Technologists. At that time, the Institute will be ready to "(1) determine by examination the qualifications of persons who apply for certification and (2) grant certificates in the appropriate grade to applicants." Three progressive grades are proposed including Engineering Technician Trainee, Engineering Technician and Certified Engineering Technologist.

Move reflects NSPE's rising interest in the growing ranks of engineering technicians. Society anticipates the eventual establishment of a National Society of Engineering Technicians, also finds it conceivable that possession of a technician certificate will become an acceptable criterion for membership in technical societies. Earlier (Chementator, Apr. 4, p. 55) NSPE elected to offer all possible assistance in fight against unionization of technicians.

Agricultural wastes to yield chemicals

Conversion of agricultural wastes into profitable chemicals may finally get on a commercial footing.

Waverly Associates, Inc., a cooperative venture financed mainly by private citizens of King George County, Va., reports that it has developed a saccharification process for making glucose, furfural, xylose, cellulose pulp, calcium and cupric gluconate, turpentine, pine oils and sugars out of such agricultural residues as corncobs, oat and cottonseed hulls, peanut shells and wood scraps. And the process' inventor, Walter Schmidt, indicates that a major Virginia paper mill and a California canning company (which uses "tremendous" amounts of crude sugar) are presently negotiating to license the flowsheet.

Commercial conversion of agricultural wastes to chemicals, though long sought, has proved an economically elusive goal until now. For example, the Dept. of Agriculture's Northern Regional Research Lab in Peoria, Ill., conducted extensive pilot plant studies on the saccharification of agricultural residues in the years directly following World War II. Starting with much the same raw materials as does the Waverly process, the Lab developed a twostage continuous process in which pentosans were hydrolyzed with dilute sulfuric acid to produce xylose, and cellulose was saccharified with concentrated acid to produce readily fermentable dextrose. Though this process was regarded as a technical success, it produced uncompetitively high-priced products and the government eventually dropped the project.

Schmidt claims that his process cuts down "drastically" on production time (from a matter of hours to a matter of minutes) and increases yields 25-30% as compared to other agricultural waste saccharification routes. Moreover, the new process is said to produce higher quality chemicals than currently made from natural raw materials.

Coming soon from General Chemical!



New Acid-Bottle Protection

Underneath the rugged, wirebound wooden outer shell, inch-thick, foamed-in-place expanded polystyrene protects General Chemical's 13-gallon acid bottle.



NEW, Safer, Lighter, Smaller 13-Gallon Acid Carboy

cushioned with expanded polystyrene overpack

General Chemical packaging research has done it again! This time with a new carboy for 13-gallon acid bottles that has just won the 1960 "Best of Show" award from the Society of Packaging and Handling Engineers. Here is a commercial acid carboy that cushions the bottle completely with foamed-in-place expanded polystyrene... also has the added protection of an octagonal wire—bound wooden shell. Look at these outstanding advantages:

- Safer! New expanded polystyrene overpack resists shock ... cushions bottle in shipping and handling.
- Lighter! 40% less tare weight.
- Smaller! Increases shipping and storage capacity by 30-35%.

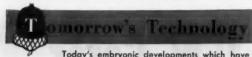
This revolutionary new 13-gallon acid carboy is now going into expanded production and will be available soon from most production and stock points. Call your nearest General Chemical office for full details and information on availability in your area.

Basic to America's Progress



GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, N.Y.



Today's embryonic developments which have special significance for chemical engineers

New polyamides for tire cord

Manufacturers of nylon tire cord have begun researching new, high-temperatureresistant polyamides. And at least two major tire companies report that they are testing tires corded of these materials.

Du Pont currently is producing experimental quantities of a polyamide called HT-1 that melts at 600 F. And Chemstrand and Allied Chemical are also working on polyamide fibers with melting points near this impressively high mark. Conventional nylon-66 tire cord melts at 482 F.; nylon-6 at 420 F.

Need for high-temperature materials stems chiefly from the 5-million-lb./yr. aircraft-tire market where cords for the most part are of nylon-66. With aircraft speed, weight and size steadily increasing, heat-generating friction on tires during flight and landing is also on the rise. Passenger car tires seldom build up temperatures in excess of 300 F., thus present tire cords enjoy a comfortable temperature margin in this application.

Free radicals as electricity source?

Free radicals as a source of commercial electricity or other forms of power?

It's technically feasible, declares newly organized Energy Conversion Laboratories, Detroit. And company now has launched a development program to make it economically feasible as well.

ECL's president, Stanford Ovshinsky, maintains—and reportedly has demonstrated on a lab scale—that the energy of free radical recombination can competitively be harnessed in compact, self-contained, mobile power packages for a wide variety of down-to-earth, work-aday applications. Among the jobs he has in mind: Electrical generators for remote regions, power plants for boats, autos, other vehicles, steam generators for sea-water desalting units.

In sighting on "practical" applications such as these, ECL has departed from the mainstream of free radical research. Most of that work is aimed at using free radical recom-

bination energy for powering rockets. But free radical rocket propulsion, unlike what ECL has set out to accomplish, doesn't have to meet wickedly competitive economic requirements—at least not at this stage of the game. Even so, it's still a far cry from being a reality.

How ECL hopes to make free-radical power competitive with conventional power or even such "exotic" power-generating schemes as fuel cells is not clear. But apparently Ovshinsky has licked some of the major problems of harnessing free-radical energy. For example, currently known techniques for capturing and storing free radicals requires cryogenic temperatures. But ECL claims that its devices, producing radicals from diatomic gases via high-energy radiation, operate at "near room temperatures." Some 90% of recombination energy can be converted to electricity on surface of thermoelectric material.

A Research and development briefs

Electrorefining of beryllium scrap may prove to be a new source of high-purity beryllium metal, suggests the Bureau of Mines, Boulder City, Nev. BuMines researchers have developed a fused-salt electrolytic process to produce better than 99.5% pure metal from scrap. Molten potassium, lithium and beryllium salts serve as electrolyte, beryllium beads as anode.

Semiconductors via atomic bricklaying will serve as electronic components in future high-speed miniaturized computers, believes International Business Machines, Yorktown Heights, N. Y. Company has developed a vaporgrowth process that permits semiconductor crystals such as germanium on gallium arsenide to be built up layer by identical layer.

New aluminum-iron-nickel alloys withstand corrosive attack of steam and water at temperatures as high as 700 F., reports Aluminum Co. of America, Pittsburgh, Pa. Alloys hold promise as cladding for uranium fuel elements in high-temperature reactors.

Ion exchange treatment of salt water may be way to beat scale buildup in desalination distillation plants. Dow Chemical has been awarded 7-mo., \$65,000 contract by Interior Dept. to research idea.

For more on DEVELOPMENTS......62



ADDED SAFETY is an important benefit when you equip your loading rack with the only gear-driven swivel joint on the market. No danger of the operator slipping on wet or icy decking while pulling down a loading arm. No chance of arm dropping or rising unexpectedly to spill hot or caustic products. No counterbalance arms, cables or pulleys to endanger clearance on the platform. The entire loading operation is constantly controlled by this easy-to-crank joint.

TROUBLE-FREE SERVICE offers an equally important advantage. This gear-driven swivel joint incorporates all the proven features of C-E's

popular US-Type Joint. It breaks like a union for quick, easy repairs on location without special tools. No need to disturb bearings when repacking. Widespaced bearings and non-split races last longer and permit greater foot/pound loading. Separate races can be reversed easily to double their life.

C-E Gear-Driven Swivel Joints are available in 2, $2\frac{1}{2}$, 3 and 4 inch sizes — styles 3, 4, 5 and 6 — in mild steel or with stainless steel wettable parts.

For more years of service, less maintenance expense and a safer loading rack, equip it entirely with Continental-Emsco's Gear-Driven Swivel Joints. There's a size and type to meet every requirement.

Write, call or wire for the full catalog and price information.



CONTINENTAL-EMSCO COMPANY

A Division of The Youngstown Sheet and Tube Company

Industrial Products Division P. O. Box 359, Dallas 21, Texas

PROCESSES & TECHNOLOGY C. S. CRONAN

Oil Company Eyes Future, Forms Chemical Offshoot

Although basically a reorganization move at present, the recently announced formation of the Mobil Chemical Co. promises a great deal more in the future. Presently accounting for only about 3 percent of Socony-Mobil's gross business, chemicals will now receive increased attention from the oil company's management.

Socony-Mobil's president, Albert L. Nickerson, described the revamping as intended to form a "flexible organization to concentrate exclusively on the profit-making potentials in chemicals." Nickerson announced that Mobil Chemical will be headed by Socony-Mobil's present senior vice president, Paul V. Keyser.

Keyser's domain will include the present Socony Paint Products Co., the petroleum additive business and the parent company's high-purity ethylene plant now being built at Beaumont, Tex. Goodyear and Houston Chemicals are planning plants at Beaumont to utilize Mobil's ethylene.

Coating Process Protects Parts During Heat Treat

A new way to protect precision metal parts during thermal treating has been developed by Chance Vought's Aeronautics Div. Coating the parts with a thin aluminum or copper spray prevents oxidation of the base metal during processing and reduces the number of rejects caused by metal loss.

Company reports that a controlled coating, 0.0001-0.005 in. thick, of aluminum or copper forms an oxide film during heating which protects the rest of the part from damage during forming, stress relieving, heat treating or annealing. Previously, oxidation caused parts to lose as

much as 0.012 in. during these operations. Maximum temperature to which the parts may be subjected is controlled by the melting point of the coating: 3,772 F. for aluminum oxide and 1,285 F. for copper oxide. Coating can be easily removed chemically, after the heat treating steps.

Coating process can be used with any metal with which copper or aluminum will not alloy. Besides ferrous metals, "space age" materials such as beryllium, columbium, molybdenum, rhenium, tantalum, tungsten, vanadium, zirconium and nickel alloys can be treated by this process.

duced by powder metallurgy or by conventional arc-melting techniques, Linde's products are exceptionally ductile and can be worked and fabricated at reasonably low temperatures. Linde's arc-fusion furnace (pictured below) produces crys-

Linde's arc-fusion furnace (pictured below) produces crystals as large as 1 in. dia. and over 1 ft. long of tungsten, molybdenum, vanadium, columbium and tantalum in addition to metal compounds such as titanium carbide, titanium monoxide, titanium sesquioxide and molydenum disilicide. Linde scientists are currently working to increase the size crystals. And they also expect to be able to make crystals of columbium carbide, vanadium sesquioxide, titanium diboride and tungsten disilicide as well.



Arc-Fusion Process Grows Large Metal Crystals

Linde Co.'s Speedway Research Laboratory (Indianapolis, Ind.) has developed a process for growing unusually large, single crystals of refractory metals and their compounds. Called arc fusion, process is distantly related to Linde's Verneuil flamefusion method which is used to grow sapphires, rutile and other oxide crystals.

Ability to produce large single refractory metal crystals offers some significant advantages to engineers who've been eyeing these materials for various high-temperature applications. For, unlike the presently available polycrystalline specimens pro-

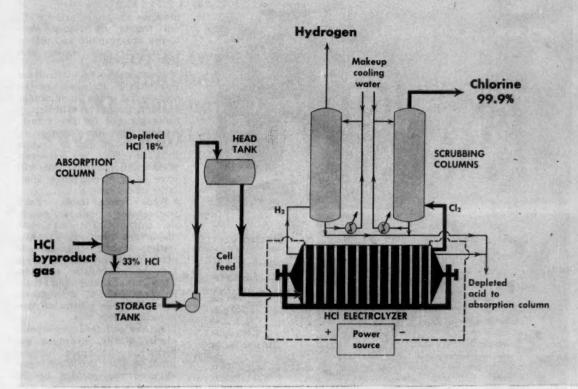
G. E. Begins Tests on Spacemen's Water Supply

Operating under a \$94,000 National Aeronautics and Space Administration contract, General Electric's Space Sciences Laboratory (Philadelphia) is using a unique vacuum pyrolytic catalysis technique for solving the problem of supplying drinking water to space travelers.

Success with this technique would enable a man in space to get his water supply from a closed system. That is, his drinking water would come from moisture recovered from the air in his environmental space and from biological wastes.

The approach involves vaporizing volatiles in the waste at reduced pressures, hence low temperatures. Then vapor is pyrolyzed over a catalyst and condensed

Condensate is said to be colorless, odorless and suitable for human consumption without filtering or use of chemical additives. How rats and monkeys react to ingestion of condensate in initial tests will prove out the physiological effects of drinking this water.



Electrolysis Saves Chlorine in Waste

- Converts troublesome waste HCl to chlorine for reuse in process.
- Offers favorable costs to meet practical economic requirements.
- Copes with handling and processing problems through incorporation of design features drawn from maker's extensive experience.

Byproduct HC's potential as a source of chlorine is now being realized at Monsanto Chemical Co., Anniston, Ala.

Using an electrolyzer developed for this purpose by the Italian engineering firm, Oronzio de Nora Impianti Elettrochimici (Milan), Monsanto has completed more than one year of successful, continuous recovery of chlorine from waste HCl.

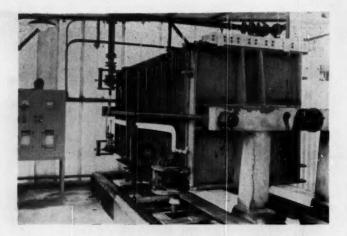
Interest by Others — Against this background of operation on a 2-ton/day pilot scale, Mon-

santo has aroused other U.S. chemical companies to the opportunities offered by electrolysis of waste HCl.

As de Nora's U.S. agent, Monsanto reports that two U.S. chemical companies, not yet identified, have plans for using this process. One company is now installing a 2-ton/day experimental unit while the other intends to install a 32-ton/day plant this year.

In touting the advantages of electrolyzing waste HCl, Mon-

santo cites capital investment cost at about \$25,000/daily ton of chlorine; power consumption totals 1,750 kwh./ton. Based on these costs plus other operating and maintenance costs, chlorine can be recovered from waste HCl for \$35.50/ton of product. Ruggedness Built In-In part, this favorable cost reflects operating reliability which de Nora built into the electrolyzer by carefully selecting construction materials to withstand HCl's corrosive attack. Cell dia-



Facts About 40-Frame de Nora HCl Electrolyzer Operating Characteristics

Current rating	amp.
Voltage across unit	92 v.
Power consumption, d. c. side	0 kw.
Muriatic acid (33% HCl feed rate)140	gph.
Number of elements	40
Nominal electrode size	q. in.
Current density	q. in.
Over-all dimensions:	
length (including capstan)	18 ft.
width	. 6 ft.
height	. 8 ft.
Over-all floor space required	10 ft.
Daily Production Capacity	
Chlorine	10 lb.
Hydrogen18,300 (

Operating Costs

operating costs		\$/Ton
Direct Costs	\$/Day	of Chlorine
Electricity (0.01 \$/kwh.)	380.0	19.0
Cooling water (0.015 \$/1 million gal.)	2.0	0.1
Labor (\$2.50/hr.)	100.0	5.0
Maintenance	55.5	2.77
Materials, i.e. diaphragms, etc	20.0	1.0
Fixed Costs		
Overhead and supervision	38.0	1.9
Depreciation (10% per annum)	111.0	5.6
Property taxes and insurance	14.0	0.7
Total Operating Costs	720.5	36.0

Less credit for value of 200,000 cu. ft./day of pure hydrogen if used.

Utility and Manpower Requirements

(Based on one ton of chlorine regeneration)

Raw Materials	
HCl gas feed material	060 lb.
Lump graphite anode material	2 . 5 lb.
PVC diaphragms	0.6 sq. ft.
Cooling water	1,000 gal.
Electricity	
For electrolysis	1,750 kwh.
For auxiliary power	40 kwh.

phragms are impregnated PVC, cell frames are Haveg, electrodes are graphite and piping connections are Haveg and PVC.

Monsanto's pilot electrolyzer was built in Italy, as are the commercial units now under construction and as will be any units planned for the future. Looking much like a filter press, the pilot unit has 35 frames held in place by end-screw pressure. Commercial units will have 40 or more frames similarly arranged.

▶What Frame Holds — Each frame holds a plate-like graphite cathode. The PVC-cloth diaphragm positions graphite lumps against the cathode plate; these lumps act as anode for the electrolytic reaction. Thus graphite lumps and graphite plate make up a single bipolar electrode for each frame of electrolyzer.

As the cell feed decomposes electrolytically, hydrogen gas forms in the space between graphite plate and diaphragm; chlorine gas gathers in the space which is partly filled with graphite lumps.

Impurities No Problem—Cell liquor for de Nora HCl electrolyzer can be made from most grades of byproduct HCl, containing up to 10% inorganic or even organic contaminants.

Byproduct HCl gas stream flows through an absorption column, countercurrent to depleted acid overflowing from the electrolytic cells. Fortified to 33% HCl, the acid stream discharging from the absorber passes through an impervious graphite heat exchanger where it gives up heat of solution.

Cooled acid flows through inlet ports into electrolyzer. Inside the cell, hydrogen ion migrates to the catholyte chambers and hydrogen gas is released at the cathode. Chloride ions migrate to the anolyte chambers which are partly filled with lump graphite anode.

Feed flows faster to the anolyte chambers than to the catholyte chambers to assure a high concentration of chloride ion near the anode surfaces. This promotes migration of chloride ion to the anodic surfaces and minimizes formation

ENTRIFUGES for

PILOT PLANT **OPERATIONS SMALL PRODUCTION** PRODUCT DEVELOPMENT

1 - DEWATERING, CLARIFYING, CLASSIFYING

The Sharples P-600 Super-D-Canter continuously handles a wide range of particle sizes in slurries with solids concentration from 1/2% to 50%. The P-600 is the largest "small" centrifuge of its type available to industry, and has high capacity, both liquid and solids. Write for Bulletin 1287.

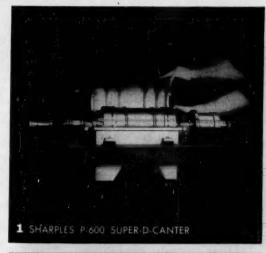
2 - EXTRACTING, SEPARATING, CLARIFYING

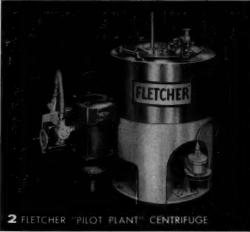
The rugged Fletcher Pilot Plant Basket centrifuges routinely handle loads up to 80-100 lbs./cu. ft. densities, with variable speed drive from 800 to 3250 RPM. Perforate and solids baskets are quickly interchangeable. Full range of "big machine" vents, feed pipes, skimming nozzles, etc. Write for Bulletin 103.

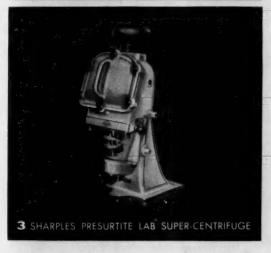
3 - SEPARATING FORCE OF 62,000 x G.

The Sharples Laboratory Super Centrifuge is standard equipment for many process operations involving the recovery of small amounts of solids from liquids, clarification of liquids, and separation of two immiscible liquids. Continuous or batch types available, motor or turbine driven, with built-in cooling or heating coils if desired, and open or Presurtite models. Write for Bulletin 1269.

All three of these Centrifuges may be scaled up directly to the performance of their larger Sharples and Fletcher counterparts.









Centrifugal and Process Engineers

2300 WESTMORELAND STREET / PHILADELPHIA 40, PENNSYLVANIA NEW YORK-PITTSBURGH-CLEVELAND-DETROIT-CHICAGO-HOUSTON-SAN FRANCISCO-LOS ANGELES-ST. LOUIS-ATLANTA Associated Companies and Representatives throughout the World of hydroxyl ion which is corrosive to graphite lumps.

▶ Handling the Products—Depleted acid, containing about 18% HCl, overflows through ports in the top of cells. Both wet chlorine and wet hydrogen gases leave the electrolyzer through top ports.

Gas streams are scrubbed with cool weak HCl solution to recover residual HCl gas and condense water vapor. Scrubbing solution recycles through a heat exchanger for recooling. Bleeding off a portion of this stream and replenishing with

fresh cool water keeps HCl con-

centration low.

Resulting gaseous products are pure 99.9% chlorine and pure hydrogen. The latter is dried further, scrubbed free of HCl with a lime solution and used in chemical processing. Or, it may even be discarded by burning.

Pure chlorine product is dried in standard sulfuric-acid scrubbing equipment and returned to the chlorination process from which the byproduct

HCl originated.

Depending on the market value, depleted HCl (18%) may be recycled, sold or even discarded.

Research in Chemical Industry Called Very Bad

Is industrial research in the chemical process industries as good as it ought to be?

No, declares Herbert C. Brown of Purdue University's chemistry department. On the occasion of his accepting the Gold Medal Award for Creative Research in Organic Chemistry from the Synthetic Organic Chemical Manufacturers Assn. in New York last month, Brown expressed this view in strong language. "Industrial research contributes only to a minor extent to the advance of chemistry. Most industrial research is very, very bad."

Chief reason for this situation, in Brown's opinion, is that the American chemical industry "suffers from too narrowly defined objectives, from too great

a use of blinders in its research." Pressures on industrial researchers are such as to force them to proceed directly to well-defined goals without achieving any understanding or even knowledge of the chemistry required to attain these goals. But the facts of research life demonstrate repeatedly that major new developments are realized not as the original objectives of research projects but as the byproduct of studies with quite different initial objectives. As a result, industry, seeking to realize the quickest and largest return on its research dollar, often gets less research results per dollar spent and less ultimate benefit for itself and science generally.

Solid-Rocket Scientists Cite Shape Advantages

By seeking to exploit the inherent transportation advantages of segmented solid-fuel rocket engines, United Technology (Sunnyvale, Calif.) has hit upon other advantages, not only in segmenting the engines, but also in making the segments conical.

First details of the heretofore secret design (Chementator, March 7, 1960, p. 56) point out that when the segments are stacked together for a complete engine, they form a cone, with the small end at the front.

Segments can be separated at any point and a nozzle inserted to make a rocket with any desired number of stages. The engines can be made in almost any size, depending on the mission and range of the rocket.

Not only is the shell of the rocket conical, but the perforation, or gas flow channel, is likewise conical, making the web thickness, or distance from the inside to the outside of the rocket's charge, constant throughout the length of the engine. This shape causes the flow area to increase as the length of the charge increases allowing an almost unlimited length without introducing the erosive burning problem arising in cylinders.

According to Willem Schaafsma, UTC's solid-rocket branch manager, other external design advantages include a reduction in aerodynamic drag, increased stability in flight and less severe aerodynamic heating.

Grace Finds Successor For Obsolete Catalyst

Capping a six-year research program, the Davison Chemical Div., W. R. Grace Co. (Baltimore) announces the development of a new silica-magnesia fluid-cracking catalyst that increases gasoline and furnace-oil yields. The catalyst, called SM-30, is a refinement of a silica-magnesia catalyst first offered for sale by Davison in 1948, but which was suspended after commercial trials.

The demise of Davison's silicamagnesia catalyst (DA-5) in 1951 was greatly mourned by refiners desiring greater gasoline and furnace oil yields but who were, at the same time, appalled by the catalyst's lack of thermal stability and regenerability. Catalyst was abandoned when commercial trial showed that its physical structure broke down after about one year in a 5,000 B/D Universal Oil Productsdesigned unit.

Thermal stability of SM-30 was attained by improving the chemistry of the manufacturing process and improving the physical structure of the catalyst. Present regenerability of SM-30 is said to be approximately equal to that of 13% alumina synthetic

catalyst.

Thus far the new product has been tested only in the laboratory and in pilot plants. But Davison believes that the validity of pilot plant tests to establish catalyst qualities has been amply demonstrated by experiences with alumina. However, a commercial trial is scheduled to start before the end of the year.

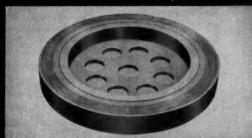
Making further comparisons of their new catalyst with alumina, Davison researchers found that at 60% conversion the volume of gasoline produced was up 7.0%; furnace oil, up 5.0%; heavy gas oil, down 5.0%; propylene, down 3.1%; and total C, down 4.8%.

new impervious graphite processing equipment . . .

DEVELOPED BY FALLS (1) INDUSTRIES



36" diameter disk is shown without mounting rings . . . this particular disk rated at 38 psi = 5%.



type "D" disk protects against implosion and explosion at the same time.

FALLS FINDUSTRIES, INC.

PRODUCERS OF BETTER PROCESSING EQUIPMENT FROM IMPERVIOUS GRAPHITE

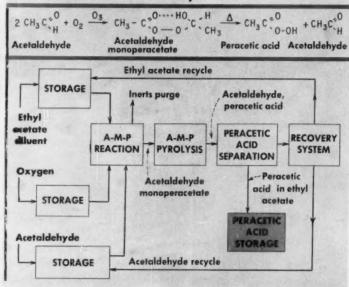
Cubic, Tube and Shell, Crossbore, Paralel and Modular Heat Exchangers; Immersion Plate Heaters; Cascade Coolers; HCI Absorbers and Plants; Towers; Centrifugal Pumps; Ball, Control, Drain, Angle and Diaphragm Valves; Rupture Disks; Pipe and Fittings; Crucibles; Thermowells.

New Process Gets Ultimate Safeguards

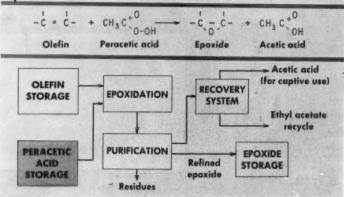
Carbide's new epoxide plant handles dangerous intermediates never before made commercially. To prevent possible disasters, engineers evolved a unique in-depth safety design.

Peracetic Broadens Expoxidation Future

Build Peracetic From Acetaldehyde



Epoxidize Olefins With Peracetic



Taking into account the dictates of Murphy's Law,* Union Carbide Chemical's design engineers have created what they believe to be a foolproof manufacturing unit to turn out a new family of epoxide chemicals. Just unveiled by Carbide, this 10-million-lb./yr. plant at Institute, W. Va., is the culmination of ten years' research into the subtleties of peracetic acid chemistry.

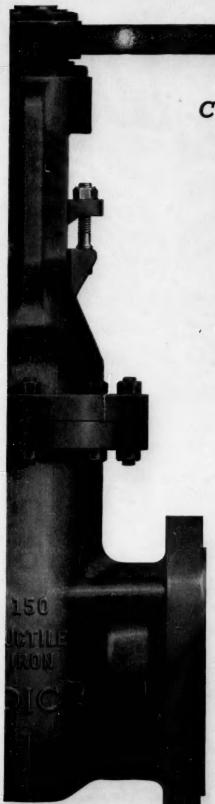
This unique unit incorporates two main processing steps: (1) Oxidizing acetaldehyde to peracetic acid; (2) Reacting peracetic acid with olefins to make a wide range of epoxides. Dangerous intermediates are produced in the first step and necessitate the safety precautions outlined below.

Alternate epoxidizing agent to peracetic acid is hydrogen peroxide which is used in several new in-situ processes announced recently. Food Machinery's Becco Chemical Div. is particularly active in this field (Chem. Eng., Feb. 22, 1960, p. 56). Yet Carbide feels its peracetic route not only gives it some raw material advantages but also enables it to make epoxides that can't be made any other way due to the absence of impurities in the epoxidizing step.

Although over 800 epoxides theoretically could be produced in the new plant, main products will be six chemicals: two soya oil epoxides, 2-ethylhexyl epoxy tallate, epoxide of a cyclic ester, vinylcyclohexene dioxide and dicyclopentadiene dioxide. Carbide is hoping these new epoxides will find wide use in resin and plasticizer applications.

► Route Signs—First announced officially more than four years ago (Chem. Eng., May 1956, p.

^{*} Murphy's Law: If something can go wrong—it will.



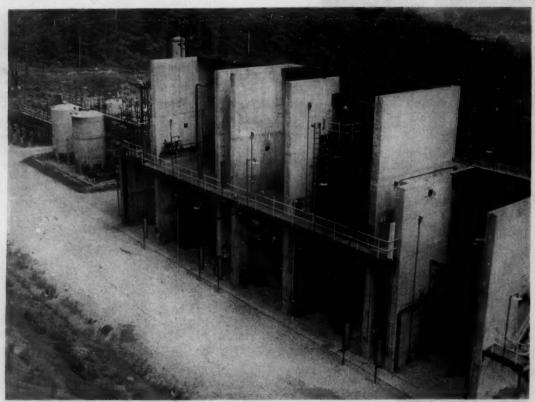
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attained in the valve business. At OIC we've worked for more than three-quarters of a century, with one unbroken chain of ownership-management, constantly guarding our standards of quality in materials, design, engineering, craftsmanship, and inspection. This long-standing reputation is reflected in the caliber of your nearby OIC distributor . . . a "quality house" with its own highly valued reputation. When you need valves and must be certain of quality, sight unseen, it will pay to phone your OIC distributor. He carries a representative stock of OIC bronze, iron, ductile iron, cast and forged-steel valves . . . and he can get 4 to 5-day delivery from OIC's warehouses or factory inventory. Since quality is a "must," and delivery is urgent, phone your OIC distributor. Quality products and prompt service are his business, and ours.



FORGED AND CAST STEEL, BRONZE, IRON AND DUCTILE IRON VALVES

THE OHIO INJECTOR COMPANY . WADSWORTH, OHIO



CONCRETE CELLS surround process equipment to direct the force of any explosion harmlessly into the hillside

110), Carbide's epoxide process is an ersatz direct oxidation route. Because complex olefins can't be epoxidized directly with oxygen in the fashion that ethylene is oxidized to ethylene oxide, Carbide gets peracetic acid, derived from acetaldehyde, to do the job.

While this involves more chemistry and critical controls. the equations for the reactions (see flowsheets) show clearly that cost of acetaldehyde does not hurt the economics of the process. For one thing, some of the acetaldehyde is recovered during formation of the peracetic acid and recycled. For another, the epoxidation reaction produces byproduct acetic acid as a roundabout derivative of the remaining portion of original acetaldehyde feed.

▶ Process Chemistry—To start off the process, acetaldehyde and air or oxygen charges to a reactor, operating at temperatures

below 0 C., along with ethyl acetate diluent and a small quantity of ozone catalyst. Purge system vents inert gases and unreacted oxygen. Product of this reaction is acetaldehyde monoperacetate, very unstable over 20 C.

Effluent flows to another reactor where carefully controlled pyrolysis decomposes the reactor product to one mole of peracetic acid and one mole of acetaldehyde. Crude peracetic acid passes to a separation system where acetaldehyde and a portion of the ethyl acetate are recovered for recycle. Refined peracetic acid is produced as a 25% solution in ethyl acetate.

Epoxides are made by reacting the peracetic acid with a variety of unsaturated materials. Crude epoxidation product passes to a separation system where ethyl accetate is recovered and recycled to the peracetic acid unit. Refined epoxide is produced either as a distilled product or residue. Recovered acetic acid is pumped to storage nearby.

► A Look at the Hazards — In traveling these new chemical paths, Carbide naturally encountered some new hazards.

In the acid unit, there are two dangerous chemicals. Acetaldehyde monoperacetate, as mentioned, is very unstable above 20 C. Peracetic acid is highly reactive, decomposing exothermically to give acetic acid and oxygen. Metallic ions can catalyze the decomposition and under certain conditions peracetic acid can be detonated. Too, the acid can react with acetaldehyde with almost explosive violence.

In spite of the extensive pilot plant experience built up with the chemicals, Carbide engineers decided that design of the first commercial unit called for extraordinary precautions.

► Designing Around Dangers— New epoxide unit was designed



TEELS DRY... top compatibility with FLEXOL PLASTICIZER EPO

No oily film . . . no dirt pick up. These are the big advantages CARBIDE has built into FLEXOL Plasticizer EPO.

This premium-grade, high-molecularweight, epoxy plasticizer demonstrates its top-level compatibility in vinyls even after hundreds of hours of rigorous testing. FLEXOL EPO gives your vinyl products full sales appeal at purchase, and lasting satisfaction in use.

Only two to seven parts of FLEXOL EPO per 100 of resin are required for stabilizing purposes. For dual use as a stabilizer-plasticizer, concentrations of only 10 to 50 per cent of the total ingredients are needed. Primary plasticizers such as FLEXOL DOP can be used easily with EPO.

FLEXOL EPO and other members of CARBIDE's big family of vinyl plasticizers are readily available in moneysaving compartment tank cars and trucks, carloads, truckloads, and drums in LCL shipments.

For prices and full specifications on FLEXOL EPO, call the CARBIDE Technical Representative in your area. Or write: Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Ave., New York 17, N.Y.

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UNION CARBIDE CHEMICALS COMPANY

UNION CARBIDE

so that only simultaneous or sequential failure of several independent safety devices could possibly result in a dangerous situation.

In addition to these precautions, the plant is isolated from the rest of the Institute complex, standing alone facing into one of the West Virginia hills. Operating equipment is placed in five three-walled concrete cells so that the force of any blast would be directed harmlessly at the hill-side. Concrete control room is located 100 ft. from the equipment and is recessed into the hill at a lower level.

Hillside locale also permits use of gravity flow for emergency flushing and dumping; a tank located above the unit is kept full of flushing solvent.

▶ Instrument for Safety — Loss of power to the unit would require dumping and flaring of all process streums. To eliminate this possibility, Carbide provided dual 13.2-kv. power cables to the unit substation, each of which draws from an independent source.

Because process conditions . must be tightly controlled, a total of 54 alarm circuits indicate any abnormal variations. Several instrument interlocks are used to prevent an operator from inadvertently creating an unsafe condition. Two switches in the control room can shut down the process in emergencies; individual vessels can also be dumped by hitting control panel switches. To keep tabs on the unstable peracetic acid product stream, specially built concentration and stability analyzers take continuous samples.

Corridors between the cells permit access to any cell without exposure to equipment in any other cell. Key accessories and instruments are located on the opposite side of the concrete wall so that operators can safely make manual adjustments as needed.

▶ When All Else Fails — On a plateau 45 ft. below the elevation of the reaction equipment is a 30-ft. by 50-ft. water-filled flare pond. In the event of emergency shutdown, contents of the processing equipment can be automatically dumped through an underground line to this pond and flared.

INDUSTRY NEWS



NEW core vessel for reactor is fitted with graphite bars.

Atomics International, a division of North American Aviation, Inc., has more than tripled the previous power output of its KEWB (Kinetic Experiment on Water Boilers) nuclear research reactor. Increased output of 2.3 million thermal kilowatts was attained after engineers installed the new stainless steel core vessel seen above. KEWB produces quick surges of energy followed by automatic shutoff, and Atomics International uses it to conduct reactor safety studies and to determine effects of intense momentary radiation on bio-

logical systems and electronic equipment. The reactor is fueled with a solution of uranium-235; it operates at the division's nuclear field laboratory near Los Angeles.

Southwest Forest Industries, Inc., is building a \$32.5-million paper mill at Snowflake, Ariz. The facility, to be completed late next year, will be able to produce 75,000 tons of newsprint and 65,000 tons of

Industry News continues on page 154



for smooth sealing in rough applications...

New 150-C Compressed Asbestos Sheet

It's new. It's Goodyear quality. And it's especially designed for tough gasketing applications involving oils, chemicals, refrigerants.

150-C's super-resistance to petroleum products comes from its unique CHEMIGUM (Buna-N) binder. It has good compression set. It's high in tensile strength—compact—uniform—highly resistant to heat and age.

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meets the following specifications:

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GOOD YEAR

INDUSTRIAL PRODUCTS

CHEMICAL ECONOMICS EDITED BY FRANCES ARNE

Resins' Stake in Easy-Care Cotton

Challenged by easy-care synthetic fibers during the past decade, cotton fought so successfully it now holds 63% of markets where easy care counts. Weapon: Treatment with resins, at a current 70-million-lb./yr.

Of the cotton fabric produced in the United States during 1960, about 50% will be treated with resins to achieve wrinkle resistance. That is, over 3 billion sq. yd. will be treated; cost of the resin ranges from 0.5-1¢/ yd.

Prompted by the commercial arrival of hydrophobic, nonwrinkling synthetic fabrics in the early 1950's, the production of resin-treated cottons had reached 20% during 1957. Accelerated growth in the years since is due principally to the increased popularity of dress goods, largely colored, which are resin-treated for wash-wear (easy-care) characteristics. Another significant factor, however, has been the burgeoning use of resin-treated white cotton fabrics in men's wash-wear

Consumption of all fabrics in uses where easy-care qualities are important, i.e., apparel and household use, is currently estimated by the National Cotton Council at about 7 billion sq. yd./yr. That leaves resins considerably more room for immediate growth as cotton continues to strengthen its bid for these markets.

► Enter White Goods—Most of the earlier resins used for wrinkle resistance were urea formaldehydes, melamine formaldehydes and certain cyclic ureas, such as dimethylol ethylene urea. These resins are generally satisfactory for use on colored goods which are seldom subjected to chlorine bleaches, but they could not be used on white fabrics destined for commercial laundering because of their inherent quality of retaining chlorine and releasing it (in the form of hydrochloric acid) during the subsequent ironing process. Cotton is extremely sensitive to this acid, and minute traces of it result in severe yellowing and even eventual destruction of the fabric.

Resistance to chlorine damage and wider usability on white cotton are prime advantages of resins, introduced commercially since 1957. These include the triazones (which are cyclic ureas chemically), modified melamine formaldehydes.

► Growth Pattern—These resins also have use in the textile industry for treating rayon fabrics, or to gain properties other than wrinkle-resistance. This makes it difficult to pinpoint consumption figures for wrinkle-resistant cotton specifically, and industry estimates vary. However, total 1960 market for thermosetting resins in textiles is estimated at between 70 and 80 million lb. on a dry basis. According to the National Cotton Council, about 63% of the total current production of easy-care fabrics (including synthetics and blends) is all-cotton fabric, while rayon and acetate account for only 13%.

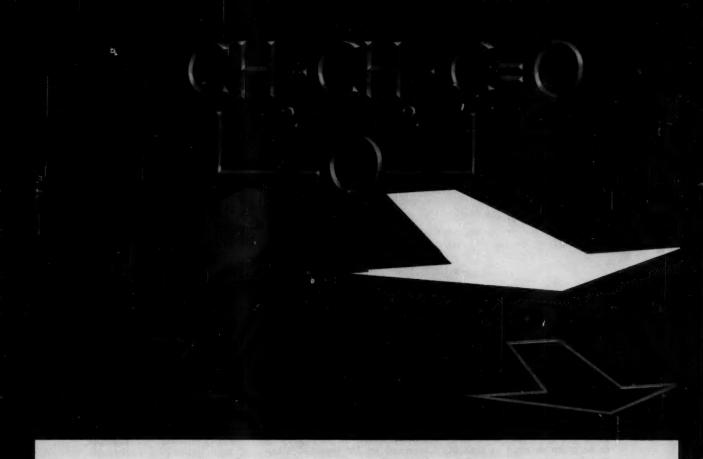
One industry source breaks down his 80 million-lb./yr. esti-

mated total as follows: About 27 million lb. will be urea formaldehydes against 22 million in 1955; 35 million will be melamine formaldehydes against 18 million in 1955; 18 million will be dimethylol ethylene urea against a consumption of 9 million in 1955.

Gagliardi Research Corp., East Greenwich, R. I., consultants to the textile industry, estimates a 70 million lb. total for 1960, of which 17.5 million lb. is methylol urea formaldehyde, 7 million lb. is urea formaldehyde (methylated), 23 million lb. is ethylene urea, 7.25 million lb. is triazones, 14 million lb. is melamines (including triazines), 1.25 million lb. is acetals and epoxies.

There seems to be a place for all of these types of resins and the choice is determined by many factors—kind of finish desired, characteristics of the fabric being processed, kind of service for which the cloth is intended, cost, and processing equipment available in a particular plant.

Future's Candidates — However, indications for the future are that the urea formaldehydes —lowest priced resin-group in the picture—will maintain present consumption levels. Melamine formaldehydes, whose growth in the recent past has been based on new modifications, will continue to grow on this basis. Cyclic ureas, too, will owe much of their future growth



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Celanese beta-Propiolactone's four-membered ring structure offers rapid, versatile reactivity to a wide variety of chemical substances—as well as self-polymerization.

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ACID DERIVATIVES

e"Difunctionality" is a result of BPL's unique chemical structure. The opening of the ring may occur on either side of the bridge oxygen, to produce various important derivatives. Applications for Celanese BPL are wide-open. Its rapid reactivity with a large group of other chemicals has already made it an important starting material for intermediates.

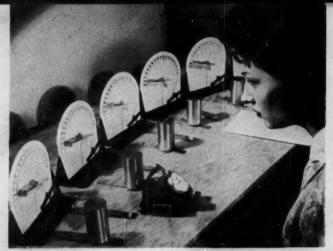
Commercially available Celanese BPL is suggested as being potentially useful in paints, textiles, detergents, lubricants, adhesives and starches. The extremely wide variety of BPL reactants includes alcohols, amines, sulphur compounds, organic acids, and water. Products include vinyl-type monomers, esters, amides, and mercapto compounds. Celanese will gladly help determine how you can profit by using BPL.

As a start, send for Bulletin No. N-61. Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 553-G, 180 Madison Ave., New York 16.

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WRINKLE recovery tester, developed by Monsanto, is used at a Rohm & Haas lab. Resin market attracts continuing research.

to new modifications such as the triazones.

▶ Urea Formaldehydes—As a class, the urea resins lack chlorine resistance, due in part to the fact that it is impossible to block all the -NH groups which pick up chlorine from bleach baths. This more or less limits their use to colored fabrics. The durability of the crease-proofing and the wash-wear effects will vary from fair to good, but in no case is it likely to be quite so good as that of certain cyclic ureas and melamines

▶ Melamine Formaldehydes -Washfastness of melamine resins is very good. Chlorine pickup is roughly the same as is shown by urea resins. As with urea, it is very difficult to block all the -NH groups with formaldehyde. Hence, a major drawback of melamine resins is the tendency to yellow on chlorination. This is reduced somewhat by high formaldehyde content, and particularly by methoxymethylation. Use of metal salt catalysis gives further improvement.

Triazine—A new creaseproofing agent is currently being marketed under the designation "triazine." All ordinary melamine resins are triazines; but in the present instance the name is used to designate a fully methoxymethylated product based on melamine in combination with an undisclosed substance or substances. The resulting product has good chlorine resistance, showing little tendency to yellow on hot chlorination,

when applied with a metal salt catalyst.

► Cyclic Ureas — One of the most important members of the group-and by far the most important until just recently-is dimethylol ethyleneurea. Use in wash-wear finishes has been based not only on durability, but also on superior chlorine resistance compared to previous types. Because there are no free -NH groups, chlorine pickup is low. However, the finish may be loosened up by repeated alkaline washes and laundry sours, and chlorine damage may then increase sharply. For this reason, DMEU has been used mostly on colored fabrics or on white fabrics that will not be commercially laundered.

▶ Triazones — Currently the most noteworthy of the cyclic ureas are the various members of the perhydrotriazone family, commonly called triazones, which have a tertiary nitrogen atom (-NH) in the ring. The major advantages of the triazones over other cyclic ureas is their resistance to chlorine damage. Although they pick up a little chlorine, they do not damage on ironing because of the basicity of the tertiary nitrogen, which buffers the hydrochloric acid released by the heat. Triazones of one type or another are enjoying considerable use at present for washand-wear finishes on both white and colored goods.

Creaseproofing resins vary considerably in chemical constitution. In each case, however, the molecule is small enough to penetrate into cotton or rayon fibers. There, under the influence of catalyst and heat, it will undergo chemical reaction. In many instances the precise course of the reaction is not known, but it has been convenient to regard it simply as a cross-linking of the long cellulose chains that make up the fibers.

All of the more commonly used resin-formers are composed of nitrogen bases chemically combined with formaldehyde. They will react readily with cellulose under moderate catalysis so that their application to fabrics can be easily controlled.

Non-Nitrogeneous Types—Because of strong emphasis on chlorine damage in this country, and because it is the -NH group which retains the chlorine, much consideration has been given to creaseproofing agents that do not contain nitrogen. Although published reports relate largely to aldehydes and aldehyde derivatives, a wide variety of compounds have been investigated.

Epoxy resins, for example, though limited by high costs, offer such advantages as durability of effect, freedom from chlorine damage, and absence of amine or formaldehyde odors. Shell Chemical has been marketing a product of trihydryl glycerine and epichlorhydrin for some time, and this year Union Carbide Chemical introduced vinylcyclohexene dioxide commercially.

Manufacturers -- Manufacturers serving this market range from large corporations to small specialty houses. The principal manufacturers are Rohm & Haas, Dupont, American Cyanamid and Monsanto. Such firms may also supply raw materials to specialty manufacturers which include Warwick Chemical Division of Sun Chemical, Proctor, Bryant and Metro Atlantic. Some of the other large corporations are basically suppliers of resin monomers. Union Carbide, for example, sells ethylene diamine to make DMEU; dimethylol-urea and diethyl amine to make triazone; and a number of other raw materials.



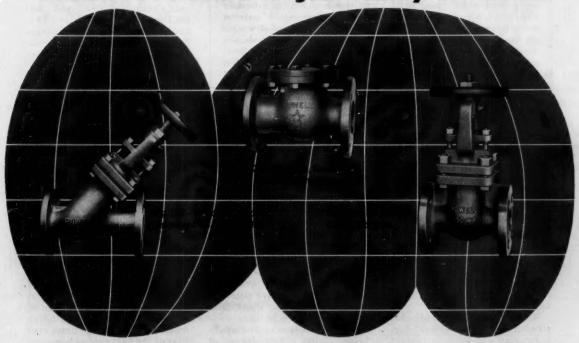
performance that makes a world of difference

The Powell Special Design and Alloy Valve Division was created to study and solve the flow control problems arising from the increasing number of corrosive fluids used in the Chemical and Process industries.

As a result, Powell has developed valves that can be depended upon for long, uninterrupted service under the most corrosive conditions; valves that require little maintenance; and that eliminate the possibility of contamination of end product.

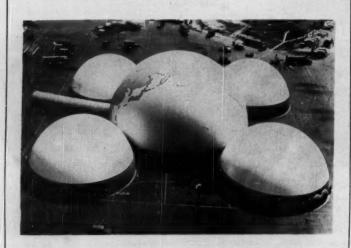
Powell offers valves to handle practically every corrosive fluid—valves of every design and in the largest selection of metals and alloys. Contact your local Powell distributor. Or write or call us direct. Our consulting engineers are at your service.

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THE WM. POWELL COMPANY . DEPENDABLE VALVES SINCE 1846 . CINCINNATI 22, OHIO

CHEMICAL PRODUCTS EDITED BY N. P. CHOPEY



World's Largest Air-Supported Structure

This missile maintenance shelter, probably puzzling to visitors at Andrews Air Force Base, is made from nylon coated with Geon vinyl. Air of 0.1 psi. from low-pressure high volume blowers supports this huge structure which can withstand hurricanes and sub-freezing temperatures. Heavy equipment can be moved in and out through 100-ft. long "pressure locks." The main structure, measuring 150 ft. dia. and standing nine stories high,

and the four smaller 50-ft. high domes can be easily folded for transportation.

Other uses for the extremely versatile Geon-coated material include: air-supported structures for outdoor swimming pools, air-craft wing covers for the Strategic Air Command and covers for radar scanning equipment used on America's Distant Early Warning System.—B. F. Goodrich Chemical Co., Cleveland, Ohio.

freedom in fabricating complex shapes for high temperature service. Combined with organic monomers, XR—65 provides tailor-made insulating resins. Other applications are in potting and encapsulation.—Silicones Div., Union Carbide Corp., New York.

Elastomers

Abrasion-resistant polyurethanes compete with metals, rubber, ceramics.

Rubber, ceramics and manganese steel, traditionally rugged in their abrasion resistance properties, are seriously challenged by polyurethane products recently developed by Du Pont and U.S. Rubber. The new elastomers actually range from very soft to hard and from flexible to rigid depending on the formulation of their raw materials, catalysts and various additives.

b 950,000-Plus—Produced by interaction of diisocyanates with hydroxy-terminated polyesters or polyethers, Uscothane (U.S. Rubber trademark) elastomer can be supplied in 1-, 2-, and 4-in. dia. rods and in 3 x 10 ft. fabric-backed slab stock, 1-in. thick. Special rods of low friction coefficient are also available.

In chute lining tests, Uscothane outlasted even manganese steel. Conventional linings usually gave way after handling 60,000 tons of iron ore; elastomer linings reportedly passed the 950,000-ton mark without showing signs of wear. Life of scrapers in a sugar grinding machine increased 10 times over that of the best rubber scrapers.

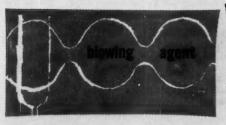
Laminating Resin

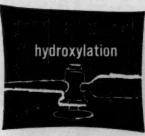
Solventless silicone resin simplifies fabrication.

Presented at the Second National Conference on the Application of Electrical Insulation, XR-65 Silicone is now commercially available in 1-pint, 1-, 5-and 55-gal. containers.

Reportedly, this material eliminated solvent removal during curing and led to important forward steps in the manufacture of spacer bars for transformers by a continuous process developed by Polyglas Div., Pittsburgh Electrical Insulation Co.

Where high-pressure laminating equipment is not available, XR-65 (100% reactive silicone) can be laminated on glass cloth by wet lay-up techniques common in the polyester and epoxy fields, giving a new degree of

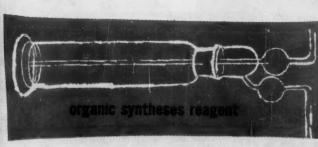






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Solvay is continually working in hydrogen peroxide applications research, as the examples above illustrate. For further information on these or other new uses, contact us directly or, if you buy l.c.l., through your Solvay distributor. Mail the coupon.

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Working temperatures range from 250 F down to -30 F. Upper limit for wet service is 160 F.—U.S. Rubber, Passaic, N. J. 78C buse Without Solvent — Adiprene L, a liquid urethane at room temperatures, is ideal in its uncured form for production of molded goods with unusual shapes, contours, undercuts, slots, projections and tapers. Shrinkage is kept to a minimum because Adiprene L is solvent-free.

Still under development at Du Pont but already available to manufacturers, the polymer in its elastomer form has found applications for sealing and paper saturation. Adhesion to metals and fabrics is reported as excellent.

Derived elastomers offer several advantages: hardness, resilience and load-bearing capacity are probably the most important of these. Vulcanizates have excellent low-temperature properties as well as resistance to abrasion, radiation, ozone, oil and greases, in addition to most chemicals and solvents.

Depending on compounding and curing methods, Adiprene L can be made hard as a phonograph record or softer than an eraser. Tensile strength is over 4,000 psi. and working temperature range is 250 F to -80 F.—E. I. Du Pont de Nemours & Co., Wilmington, Del. 80A

Caused by one-celled protozoan parasites transmitted when chickens eat eggs of coccidia present in droppings of diseased poultry, coccidiosis thrives where crowding occurs and accounts for as high as \$150 million per year losses to world farmers.

Drug is nontoxic even in dosages of 15 times those prescribed and is unique in its water solubility properties.—

Aries Associates, Stamford, Conn. 80B

Glass Fiber

Impregnation with epoxy resins makes new material for fabrication.

Users of storage, transportation and distribution tanks for corrosive substances will discover that Poxyglas tanks have three to four times the strength of conventional reinforced plastic tanks.

Poxyglas is produced by a patented process combining thermosetting epoxy resins and strong glass filaments in a precision winding pattern. After glass fiber is wound on a steel mandrel to reach the desired thickness, heat treatment transforms the liquid epoxy impreg-

nant into solid resin bonded to the glass filaments.

A programmed electro-hydraulic servo system gives exact process control and reproducibility in manufacturing the tanks.

Poxyglass combines the corrosion resistance properties of glass and epoxy resins to provide a light and strong product suitable for corrosive service, or for handling substances in food and soap processing that wont stand contamination.

Tanks are immediately available in sizes up to 12 ft. in diameter and designed for atmospheric pressure and a maximum operating temperature of 250 F.

— Black, Sivalls and Bryson, Inc., Kansas City, Mo.

80C

Lubricant

Offers excellent temperature-viscosity index at elevated temperatures.

By virtue of its chemical and physical properties a new colorless mobile liquid, diphenylbisn-dodecylsilane, fits the dual role of high-temperature lubricant and heat transfer fluid. Little change in fluid appearance and no corrosive effects on metal parts (Ag, Ti and steel) have been noticed during ex-

Mepyrium

Chicken disease prevented and controlled by new drug.

Mepyrium, recently presented at the annual Canadian Institute of Chemistry meeting in Ottowa, is reported to be the first effective drug against all six types of coccidiosis. Its development is credited to combined efforts in eight countries. Now made from low cost petrochemicals such as acrylonitrile, butyronitrile, and alpha picoline, Mepyrium is fed either as preventive (125 grams/ton of feed) or as a drug to cure the disease.

Newsworthy Chemicals-

Page Number is also Reader Service Code Number

Geon-coated nylon for air-supported structures	78A
Solventless silicone in high temperature insulators	78B
Polyurethanes as new abrasion-resistant materials	80A
New drug fights poultry disease	80B
Impregnated glass fiber in tank manufacturing	80C
Lubricant for high temperature aircraft service	80D
Plastic caps add to life of steel bolts	82A
Urethane foam as filter in air conditioners	82B
Vegetable gum brightens metals in electroplating	82C
Aluminum silicate filler for GRS rubber	

- For more details, use Reader Service Card -

HOW TO STORE LIQUIDS AT 中国20° 厅。



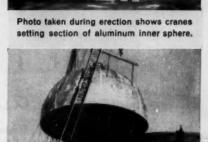


-built HORTONSPHERES® do it for Linde at Pittsburg, California

CB&I engineered, fabricated and erected these special Hortonspheres for Linde's new plant at Pittsburg, California, using Linde-approved designs. One is used to store liquid oxygen at -297° F. The other will store liquid nitrogen at -320° F.

Their construction is unusual . . . each structure is actually a sphere within a sphere. A specially designed rod support system cradles the 38'9" diam. aluminum inner sphere within the 46'9" diam. carbon steel outer shell. Heat transfer to the inner sphere is minimized by powdered insulation placed between the inner and outer shell.

Cryogenic storage calls for vessels of special design . . . and the know-how to build them. Linde Company used this know-how from CB&I's seven decades of craftsmanship in steel. So can your company. Write for further details.



Above and below: Experienced CB&I erection crews make tough jobs look easy.

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haustive thermal and other metallurgical tests.

Metal & Thermit suggests the new material as a base stock for high temperature aircraft gas-turbine lubricating oil where stability in the range of 500-700 F. is required. Or as a hydraulic fluid for actuators it will operate over a 0-700 F.

range. Low vapor pressure and high temperature stability also make it suitable as the base stock in lubricating oil and grease formulations.

Bulk density is 7.45 lb./gal., and -25 F. and 530 F. are the pour and flash points respectively. — Metal and Thermit Corp., Rahway, N. J. 80D



Plastic Caps Add to Life of Steel Bolts

Bolts capped with a durable and corrosion-resistant plastic to extend their usable life under high-rust on chemically corrosive conditions are giving a new boost to the common steel bolt used in industry.

Early attempts to use plastic in place of stainless steel failed because the thin plastic layer molded over the bolt head was squeezed off the underside when bolt was tightened. Kralastic MM, a new ABS plastic, solved this "squeezing" problem. This resin-rubber plastic is designed to resist cold flow under hightorque squeezing action.

Millions of the plastic-capped bolts are now in production and their cost is about half those capped with stainless steel. For news about another Kralastic grade see *Chem. Eng.*, May 2, 1960. p. 78.—Clear-Cite Products, Chicago. 82A

BRIEFS

Urethane foam that can be repeatedly washed even in automatic washers, wrung out like a sponge and reinstalled, will be the filtering medium of more than half of all 1960 model room air conditioners. Called ScottFoam, it has a three-dimensional structure of skeletal strands connected by thin, membrane-like windows. It can be easily cut and doesn't need spraying with oil or other fluids to trap airborne particles. Produced in six grades of porosity, it is available in thicknesses up to 6 in.—Scott Paper Co., Chester. Pa.

Vegetable gum derived from okra brightens nickel, silver, copper and cadmium plates in electroplating baths. Salts such as sodium chloride and sodium sulfate and organic acids have little effect on okra dispersions but trivalent aluminum ions cause coagulation. Gum dispersions are not appreciably affected by nonionic surface-active agents. Comes in granular form and as 200-mesh powder.-Morningstar - Paisley Inc., New York. 82C

Modified APS-106 aluminum silicate filler for GRS rubber offers faster cures and easier processing because of improved wettability and better dispersion properties. New material has demonstrated greater modulus and tensile strength, as well as better electrical insulating properties, when compared with other fillers.—Minerals & Chemicals Corp. of America, Menlo Park, N. J. 82D

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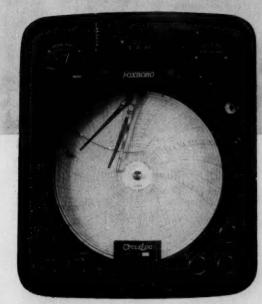
postcard (p 185)

"Push-button"automatic control for complex time-schedules!

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 schedules reproduced exactly by push button schedules changed instantly by turn of knob

TOP TEMP



With the Foxboro CycleLog Controller you can establish intricate control programs for process variables with a "twist of the wrist" . . . change them just as easily! You merely "dial" starting point, rate of increase to holding point, holding time, and rate of decrease to shut-down. A push button starts automatic control of cycle . . . repeats it precisely, as often as desired.

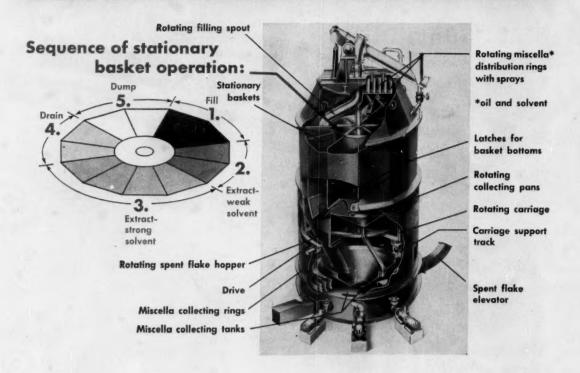
Such bothersome industrial control problems as simple batch polymerizations, dissolvers, rubber processing (to name just a few) are being solved every day with this compact, flexible system. No more spoiled batches, "off-spec" product, or expensive re-runs. Operators report better quality, better uniformity, and increased production. And it all adds up to more efficient, profitable manufacturing.

Your nearby Foxboro Field Engineer will be glad to discuss, at your convenience, how CycleLog Control can be used to advantage on your processes. Why not give him a call, or write for details today to The Foxboro Company, 367 Neponset Avenue, Foxboro, Massachusetts, U.S.A.

pneumatic instrumentation

DEVELOPMENTS ...

PROCESS EQUIPMENT EDITED BY F. C. PRICE



Basket Extractor Keeps Beds Stationary



WORKING UNIT strips oil from 150 tons of soy beans daily.

New unit rotates everything but the baskets to get quiet beds which effectively filter extract.

In a tail-wags-dog sort of operation, the French Oil Mill Machinery Co. has built a basket extractor in which the baskets are stationary and the auxiliary equipment has all the motion.

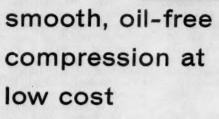
This topsy-turvy approach to extractor design solves an important problem—how do you keep the bed of solids to be extracted motionless in a continuous unit? (A quiet bed acts as a filter to remove small solid impurities from the circulating extract. Any vibration or motion

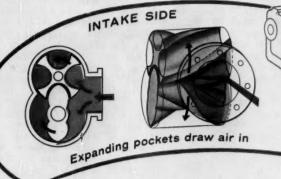
in the bed would let the particles slip through.)

French achieves quiet beds by holding the baskets motionless and rotating the filling, extracting, and dumping equipment. This design has an added advantage—since the baskets and their contents are the heaviest part of the machine, the rotating carriage needs no bearings and simply rides on rollers on a circular track.

First commercial installation of the new unit extracts oil from

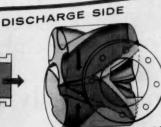
How the Axi-compressor provides

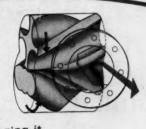












Pockets carry air to discharge side, squeezing it axially toward the discharge port and forcing air out

BECAUSE of its unique principle of operation, the Ingersoll-Rand Axicompressor offers many advantages for the compression or evacuation of air or gases.

It is a simple, durable machine, consisting essentially of only two moving parts—a helical four-grooved gate rotor and a mating two-lobed main rotor. The main rotor is driven directly by an external motor, transmitting motion to the gate rotor through precision-machined helical timing gears. The two rotors do not touch each other or the casing, hence are not subject to mechanical wear. No lubrication is needed within the compression chamber and there is no oil contamination of the air or gas handled.

The operation is illustrated in the drawings above. The helical rotor sections overlap, giving a smooth discharge. Being a high-speed machine, the Axicompressor is suitable for low-cost direct-connected electric motor drive. This results in a compact unit that can be installed in a small space with a minimum of foundation, thus further reducing costs.

Ask your I-R engineer how the Axicompressor can cut your compression or vacuum costs—or write for bulletin.

Ingersoll-Rand

CAPACITIES: 100-12,000 cfm PRESSURES: to 15 psig or 22" Hg vacuum



PUMPS . CENTRIFUGAL & RECIPROCATING COMPRESSORS . DIESEL ÉNGINES . AIR & ELECTRIC TOOLS . TURBO BLOWERS . STEAM CONDENSERS

150 tons/day of soybeans at Southern Soya's Estill, S. C., plant. Extraction efficiency has exceeded design expectations and dry meal averages less than 0.5% oil. In fact, the stationary bed gives such good extraction that even French doesn't understand why.

Everything in Sequence — Let's trace the cycle to see how the machine gets such good extraction. Each basket goes through the following sequence of operations: filling, washing with weak solvent, washing with strong solvent, draining and dumping. (Remember—it's the baskets which are stationary while the rest of the equipment revolves.)

We'll check the cycle by following the solvent flow through the unit, starting with a basket which is ready to dump. The flakes in this basket are completely extracted and the solids bed is draining prior to dumping. While two baskets are draining in this manner, the next one is being washed with fresh solvent.

Liquid drainings from all of these three baskets are collected as 2-3% miscella (miscella is an extraction term for oil-bearing solvent—the percent is the oil content). This miscella is sprayed on the bed in the next previous basket, and after it drains through the flakes it is collected again, now 8-10% miscella.

Miscella Gets Richer — The 8-10% miscella is next sprayed on several baskets at once, and as it drains through the beds, part of it is recycled and resprayed on the same baskets. Miscella (20%) which isn't recycled is pumped directly to the top of the extractor where it mixes with incoming fresh flakes which contain 17-20% oil.

The miscella-flake slurry discharges through a rotating spout into an empty compartment which has just been dumped. Miscella drains from the basket bottom as the flake bed builds up to act as a filter medium.

The miscella is then pumped

to the compartment just previously filled where a solids bed is established. (We skipped over this one in the sequence.) This bed effectively filters the miscella—now at 25%—before it leaves the unit to go to the solvent-oil recovery system.

The Mechanics—Each basket compartment has a bottom gate which is automatically unlatched, dropped open, pushed closed and relatched as the carriage rotates. The entire cycle takes about 40 min. At the end of the circuit, spent flakes fall into a conveyor at the bottom of the unit. Flakes are transferred to a separate unit for removal of last traces of solvent.

Miscella collecting pans (below the baskets) and distribution rings (above the baskets) rotate and keep the various grades of miscella directed to the proper stages of the cycle. The entire rotating carriage is driven by a pinion which engages a ring gear sized to the full diam. of the extractor.—The French Oil Mill Machinery Co., Piqua, Ohio. 84A

Mull It Over Continuously With New Mixer

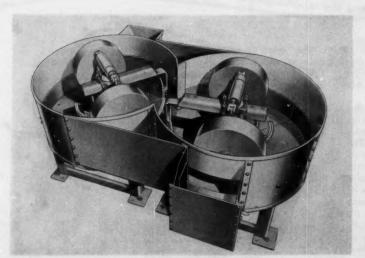


FIGURE-EIGHT describes movement of material through Simpson Multi-Mull. Constant interchange between pans is secret of thorough mixing.

Double-muller alignment boosts output 50% over comparable batch mixer.

"Divide and conquer," timehonored military maxim, has been modified to "divide and mix" in the new Simpson Multi-Mull which is claimed as the first proved continuous commercial muller.

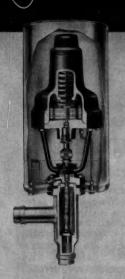
Based on the theory that two of a kind are better than one, Simpson combined two batch mullers so that their plows overlap and exchange material between the two pans. Two advantages are claimed for this arrangement:

• Capacity is higher because charge and discharge



Special Control Valves

TO MEET THE RIGID SPECIFICATIONS OF THE NUCLEAR AND CRYOGENICS INDUSTRIES



This spotless room is used only to assemble ultra-clean control equipment for the nuclear power field and guided missile program. It is pressurized and conditioned by filtered air. Nothing in the "White Room" is touched with bare hands. Daily cleaning is accomplished through vacuum outlets in the walls.

Technicians use special pre-cleaned tools to assemble the equipment. They are outfitted in lint-free garments and plastic boots. These precautions insure that each piece is immaculate until capped and sealed for shipment.

SS24RA—a typical example of the severe standards required in the nuclear power industry. Fisher engineers specially designed this control valve to handle "hot" radioactive material within the body as well as surrounding areas. The alloy body was hermetically sealed by inert gas seal welds. When subjected to a mass-spectrometer leak detector test, a leakage of less than 1x10-6cc per second, at standard conditions was shown.

Finally, the entire control valve is completely encased to permit decontamination of the system. Constructed in 1" to 12" sizes.

Call on Fisher engineers when you have control valve requirements that must conform all, or in part, to nuclear or cryogenics specifications.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY ...

FISHER GOVERNOR COMPANY

Marshalltown, lowa / Woodstock, Ontario / Rochester, England
BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA-



SINCE 1880

time of batch operations is eliminated.

 Mixing is complete enough to allow continuous feed and discharge.

The design overcomes the basic shortcoming of one-pan continuous mixers—that of material short-circuiting. Here the figure-eight mixing path requires the incoming materials to make a complete circuit of both pans before it gets to the discharge—and only half of the mix gets from pan one to pan two on a single pass.

It Works This Way—Material

hat works This Way—Material charged to the first pan is assimilated into the mass of mulled material which is constantly circulating between the two pans. In each pan, the material is subjected to multiple passes by the muller and plows. The two machines exchange material equally at the overlap point.

Mulled material discharges continuously over an adjustable gate in the second pan. Height of the gate determines retention time within the muller. Multi-Mull is available in six models with capacities from 6 to 120 cu. ft. which handle from 25 to 2,500 cu. ft./hr. depending on the material.—Simpson Mix-Muller Div., National Eng. Co., Chicago, Ill.

Sealless Pump

Magnetic drive eliminates need for rotating seal.

Magnedyne pump has no seals to leak corrosive fluids. Unlike so-called canned pumps, however, standard motor drives the impeller. It's all done with magnets—one on the motor

For More Information

about any item in this department, circle its code number on the

Reader Service

postcard (p 185)

shaft, another on the impeller shaft, separated by a stainless steel diaphragm. Internal magnet, a special ceramic fused from barium titanate and ferric oxide, is noncorrosive.

Pump's wetted parts come in bronze, stainless steel, titanium and plastics—for various corrosive services. Internal bearings are either carbon graphite or Teflon. Capacity range: 10-25 gpm. at 35-10 ft. head.— Strand Co., N. Y., N. Y. 88A



Bench Scales

Designed for accuracy under rugged industrial use.

Platform-type bench scales for heavy-duty general-purpose weighing have a minimum of moving parts. For protection against shock in loading and unloading, scales have overload and bumper springs. Fast performance is possible with an adustable hydraulic dashpot which controls weighing speed.

Scales come in four capacities, 50 to 300 lb., with 1- to 8-oz. graduations on 15-in. direct-reading dials. A quick tare device, which permits 25% of dial capacity to be tared off, is optional. To make the scale portable, put it on four-wheel rolling stand with height adjustments from 25 to 30 in.—

The Exact Weight Scale Co., Columbus, Ohio.



PVC Globe Valve

Can be repacked in position under full line pressure.

Globe valves molded of nonplasticized polyvinyl chloride resin are available with either screwed or socket-weld ends. Having high strength-to-weight ratio, valves show smooth internal surfaces to flowing fluid thanks to injection molding technique. As typical in this type of valve, unit handles wide range of corrosive products including chemical salt solutions.

The valve stem, of particularly heavy design, is set at a 45-deg. angle to minimize flow turbulence. In the fully open position, the valve back-seats against the housing to allow repacking under pressure. Furnished in ½- through 3-in. sizes, valve holds 125 psi. at 145 F.—Dorak Products Corp., New York, N. Y. 88C

Porcelain Valve

Aluminum armor makes valve stronger and safer.

The combination of aluminum jackets and porcelain valve bodies makes units both rugged and reportedly able to withstand the most severe corrosive service. High-strength silicon aluminum castings are permanently cemented over the porce-

EQUIPMENT
NEWS
Continues on . . Page 164

EC&M Fuseless AIR-BREAK STARTER GIVES Certified 100/150 MVA FAULT PROTECTION

NO SINGLE PHASING FROM BLOWN FUSES!

NO COSTLY REPLACEMENT FUSES TO STOCK!

Gang-operated Disconnect Switches Grounded for Safety in Open Position. Mechanically Interlocked with Contactor... Never Open Under Load

No Fuses. Bus Bars Throughout

✓ 3-way Door Interlock.On, Off and Open—with Positive Interlocking between Door, Disconnect and Contactor for Maximum Personnel Protection

✓ Heavy-duty DC Operating Magnet. No Chatter—No Hum

FRONT ACCESSIBLE WITHOUT ROLL-OUT!

Phase barrier and arcchutes slide out. All starter parts exposed and accessible for easy inspection and maintenance



Get the complete story on certified <u>fuseless</u> fault protection for high-voltage motor drives. Write for Bulletin 8130A



SQUARE D COMPANY

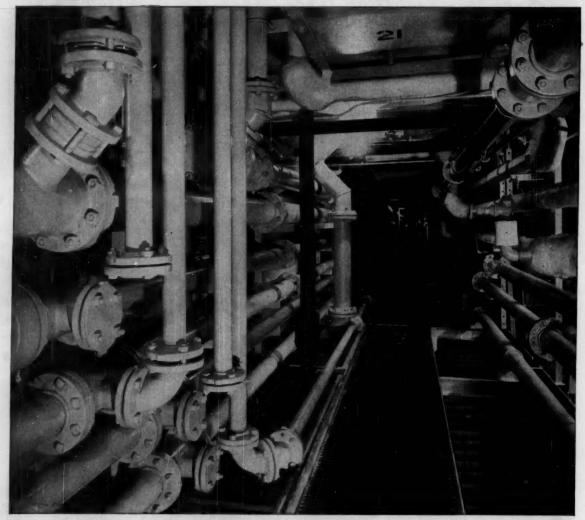
EC&M DIVISION . CLEVELAND 28. OHIO

wherever electricity is distributed and controlled

2635



SARAN LINED PIPE



After six years of hot sulphuric acid . . . Saran Lined Pipe still performs dependably

When 20,000 linear feet of pipe must carry a constant stream of hot sulphuric acid... when production requirements make pipeline failure intolerable... pipeline dependability is the lifeline of the plant. For the past six years, Saran Lined Pipe has carried dependably an unending flow of corrosive chemicals at Industrial Rayon Corporation's Painesville, Ohio, plant. The installation shown above carries hot sulphuric acid and other chemicals used in Industrial Rayon's Continuous Process method of making tire cord. This Saran lined supply and return piping, serving all of the plant's spinning machines, carries the solutions from lower levels to spinning machines on the main floor. Pumping pressures range from 45 psi upward, and solution temperatures are above 125° F.

The Saran Lined Pipe was installed in 1953 and has been in continuous use since. Maintenance costs have been extremely low and I.R.C. engineers report that, during these six years, Saran Lined Pipe has performed dependably under their corrosive operating conditions.

Whenever dependable piping systems are required, whatever the degree of corrosion or chemical activity, consider Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can easily be cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2282AK7-25.

THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN

MAKING NEW AMMONIA PLANTS



STILL BETTER INVESTMENTS

Recent developments by The M. W. Kellogg Company in steam reforming make the production of ammonia by this process more efficient, more economical to install and operate, and more adaptable to individual conditions than ever before.

IN GAS PREPARATION, Kellogg now can design a plant for any combination of waste heat recovery suitable to the situation, and can achieve heat balance in the plant if desired. High pressure and low pressure feed can be used as economics dictate. Feedstocks can include naphtha as well as natural and refinery gas.

IN GAS PURIFICATION, Kellogg now can offer the optimum combination of methods to accomplish each step, including MEA and hot carbonate to remove CO₂, and copper liquor and methanation to remove CO. Throughout the entire installation—from furnaces to synthesis converters—Kellogg's improved steam reforming process offers today's ultimate in low-cost, high-yield ammonia plants.

Among the many ammonia plants engineered and/ or erected by Kellogg throughout the world since 1944 is the 300 T/D installation for Solar Nitrogen Chemicals, Inc. at Lima, Ohio, shown above. M. W. Kellogg is now designing and will erect a second plant for Solar—at Joplin, Mo.

For detailed engineering and economic data on Kellogg's steam reforming process, write for new booklet.

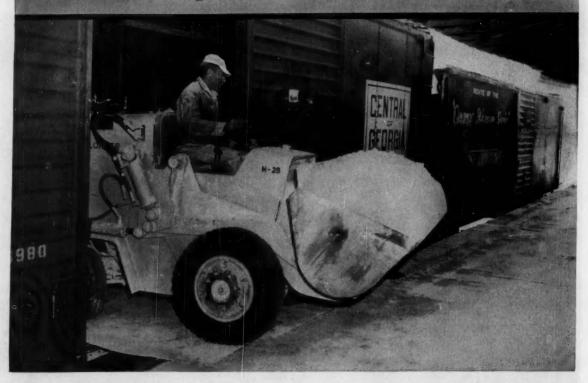
THE M. W. KELLOGG COMPANY

711 Third Ave., New York 17. A subsidiary of Pullman Incorporated

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires



"H-25 PAYLOADER" delivers 25% more, increases operator comfort and safety"*



*Mr. J. B. Evans, partner of Evans, Reed and Williams at Sylvania, Georgia, says, "The new H-25 'PAYLOADER' is moving better than 25% more material than the previous model HA. The smooth operation assures cleaner working floor conditions, faster delivery, plus operator comfort and safety. It's giving allaround satisfactory service. Our original model HA gave exceptionally good service for 9 years and our larger model HAH operated six years before it had a major overhaul."

There are many reasons why the Model H-25 will dig, carry and deliver more tonnage with lower operating and maintenance costs than anything near its size. One is the powershift transmission — exclusive in its class — with two speeds forward and reverse. Others are the power steer; power-transfer differential; 4,500 lbs. breakout force; 2,500 lb. carry capacity; shortest turning radius of only 6 ft.

The H-25 has been engineered to provide extraordinary protection against dust and dirt damage: triple air cleaner system; cartridge-type oil filter on all three oil systems; sealed, self-adjusting service brakes; parking brake enclosed in transmission; special grease and oil seals on all vital points.

Your Hough Distributor wants to show you what an H-25 or larger "PAYLOADER" tractor-shovel can do on your work. See him soon or send for full information.

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U.S.I. CHEMICAL NEWS

July

A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries

19

60% Interest in Mallory-Sharon Metals Acquired By National Distillers

New Name-Reactive Metals, Inc.

National Distillers, formerly one-third owner of Mallory-Sharon Metals Corporation, has recently acquired a 60% interest in the company. The operations of Mallory-Sharon Metals are being integrated with those of its now 100%-owned subsidiary, Johnston & Funk Metallurgical Corp., and the combined company is to be known as Reactive Metals, Inc. Sharon Steel Corp. owns 40% interest in Reactive Metals.

This reorganization will make Reactive Metals one of the world's largest producers of special metals such as zirconium and titanium sponge and

mill products, and columbium, hafnium, molybde-

MORE



Zirconium oxide kiln in chemical processing section of Reactive Metals zirconium sponge plant at Ashtabula, Ohio,

Corrosion Costs Slashed by Large-Scale Titanium Use

Two ore processing units, completed in the past year, are the first Chemical Process Industry installations to make extensive use of titanium equipment in highly corrosive service. The decision to use titanium was based on 15 months of pilot plant studies in which the higher-priced metal proved most economical in terms of equipment life expectancy.

Titanium was tested against stainless steels, Hastalloys, Monel, other alloys and nonmetallics, for leaching reactors and piping to handle mixed ore and 10% sulfuric acid and for oxidation autoclaves and piping subject to dilute acid, all at high temperatures and pressures. Titanium showed almost no corrosion, came out first among all the mate-

rials tested.

As a result of these

MORE

Production of Nonfood Aerosol Units Estimated at 575 Million In 1959, C.S.M.A. Reports

1959 Figure Represents 22% Increase Over 1958. Hair Sprays Lead for Forth Year, but the Figure Is Down From 1958

On May 18, at the annual meeting of the Chemical Specialties Manufacturers Association in Chicago, it was revealed that an estimated 575 million nonfood aerosol units were produced in 1959. This represents a growth of 22% over 1958,

when 470 million units were estimated. The retail value of these units in 1959 was about 34 of a hillion dollars.

was about 34 of a billion dollars.

The CSMA figure is based on reports from container and valve makers and on responses from 58% (115 out of 198) of the known aerosol fillers—adjusted to account for nonreporting fillers. The actual

number of units reported for the year was 498 million. How the Major Products Ranked

For the fourth year now, hair sprays topped the list, and accounted for 16% of the total units reported. Shaving lathers moved up from third to second place to claim 15% of total production. Insect sprays advanced from fourth to third spot with 13%. Room deodorants, formerly second, ranked fourth with 12%. Coatings remained in fifth position with 11%.

requirements of men over 60 were determined by the nitrogen balance technique. It was discovered that they needed from 2.4 to 3.0 grams of methionine per daymore than twice the amount of 1.1 grams reported necessary for young men.

Nitrogen equilibrium was established for a group of men over sixty fed a diet of ordinary food with known nitrogen content. With the information thus obtained, a semi-synthetic diet was given them which contained the same amount of total nitrogen. This diet furnished all essential and non-essential amino acids in the ratio found in egg protein.

Methionine Needs Reported

Higher in Men Over Sixty

In a study reported recently, methionine

This second diet included three grams of methionine per day. The methionine level was gradually reduced until a negative nitrogen balance was obtained. Control and test diets were alternated until the methionine needs of the men were determined accurately.

U.S.I. Announces Booklet On Polyethylene Printing

"Printing of Polyethylene" is the title of a new U.S.I. booklet now available. It's the latest addition to special U.S.I. literature designed to help achieve finest results with polyethylene film.

The new booklet discusses methods of film treatment, printing techniques, printing inks and field test procedures. It also contains a glossary of commonly-used ink and printing terms.

A copy of the 16-page booklet can be obtained by writing to the Technical Literature Department, U.S.I. Chemical News, 99 Park Avenue, New York 16, New York.

NONFOOD AEROSOLS REPORTED IN 1959 COMPARED TO 1958 (1948 in millions of unit) Finduct Harryshays 79 1 99 6 Shaving Lathers 72.6 45.3 Insect Sprays 65.9 42.3 Rumn Hamilton 59 44.1 Codings Colognes & Perfumes Glass Cleaners Hoymethold Products Office Prior Hum Democratic and Democratic Intent Than Hair Sprays, Shaves, Colognes & Perfumes &

It is to be noted that aerosol cologne and perfume production went up from 14 to 34 million reported units in 1959. And that containers under one ounce accounted for 17% of the perfume and cologne units reported for the year. A separate category for Waxes and Polishes was set up under Household

Products in 1959, and revealed a total of 12 million

MORE

July

U.S.I. CHEMICAL NEWS

*

1960

CONTINUED

Aerosols

units for the year. Also for the first time, a separate figure for Canadian aerosol production was included—a total of 20 million units from eight Canadian producers. These figures are included in the overall survey for continuity purposes.

U.S.I. Products Used in Aerosols

U.S.I. products, ethyl alcohol and polyethylene, are playing an important role in the large and steady growth of the aerosol industry. Anhydrous ethyl alcohol is a vital ingredient in the top-ranking products—hair sprays and room deodorants—and in the growth leaders—perfumes and colognes. It is widely used in other personal products, and in pharmaceuticals now sold in aerosol form. Polyethylene is used for dip tubes and valve parts.

Last year we reported a forecast by one of the largest makers of aerosol containers—that total production of aerosols would reach 555 million units in 1959. It looks as if the prediction wasn't optimistic enough. Let's see what 1960 brings!

CONTINUED

Reactive Metals

num, tantalum, tungsten and vanadium mill products. With total assets of over \$50,000,000, the company plans to continue emphasizing the production of a wide variety of special metals so that it will be in a position to expand its interest in one or all of them as markets develop.

The contract under which Brideport Brass Company has been managing Mallory-Sharon Metals will be revised to cover Reactive Metals. Executive offices of Reactive Metals will be located at Bridgeport, Conn. Titanium and zirconium sponge division headquarters are at Ashtabula, O.; columbium, molybdenum and tantalum mill products division at Huntsville, Ala.; titanium, zirconium and special steel mill shapes division at Niles, O.

CONTINUED

Titanium

studies, titanium was employed as follows: In leaching reactors, overflow pipes were lined with titanium; reactor draft tubes, nozzle inserts, and pipe lines connecting reactors, slurry heaters, slurry coolers and flash tanks, were made of titanium. In autoclaves, titanium was used for agitator shafts and blades, autoclave nozzles, connecting piping including letdown valves.

To cut costs, engineers made exact calculations of metal thicknesses required, figured sizes and lengths of pipe as precisely as possible, carefully arranged equipment layouts. In design and production, many basic problems of titanium fabrication were successfully solved, and many economic considerations worked through. Other companies in the process industries can now apply the considerable knowledge gained on this project to utilize the vast potentials of titanium as a corrosion-resistant material.

New U.S.I. Ethyl Acetate Data Sheet Now Available

Three grades of ethyl acetate are described in a new technical data bulletin just released by U.S.I. The grades are: commercial 85-88% ester; 95-98% ester; and 99% ester (acetic ether). Data include U.S.I. specifications, properties, shipping information and uses.

Ethyl acetate is the standard fast-evaporating solvent for nitrocellulose. It is used as a solvent to process or produce iacquer, varnish, smokeless powder, photographic film, pharmaceuticals, perfumes, textiles, plastics, coatings, cleaners and many other products. It is also a chemical intermediate for the manufacture of ethyl acetoacetate and ethyl sodium oxalacetate.

For a copy of the new data sheet, contact your nearest U.S.I. sales office or Technical Literature Dept., U.S.I. Chemical News, 99 Park Ave., N. Y. 16, N. Y.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

New compound, said to lower elevated blood cholesterol levels dramatically with virtually no side effects, is now on market. No dietary restrictions necessary. Contains aluminum nicotinate which hydrolyzes in body.

Ne. 1610

Bensetriflueride and its ortho-meta-, and parachloro isomers now available on commercial scale. Suggested uses include manufacture of diuretics and tranquilizers, dyestuits, biocides, dielectric fluids.

Stabilized formaldehyde solutions now available are said to permit safe storage at temperatures well below previously recommended levels. Minum for 37% solution (1% methanoi) has been reduced from 90 F to 60 F.

No. 1612

Tritiated L-histidine. new radioactive material for bjochemical traces studies, now available. Since D-form is absent, this pure tritiated L-amino acid is said to eliminate background interference in radioautographs.

No. 1613

Special circular slide rule for solving atomic fallout problems is being sold. Quickly tells what radiation level will be anytime after an area experiences atomic fallout from atomic bomb or similar nuclear occurrences.

Pure crystalline xanthopterin now being offered. Said to extend possible application of compound in research on purine and nucleic acid metabolism in normal and neoplastic cells. We. 1815

Activated charcoal paint now available can be coated on any surface to give odor adsorptive properties to rooms, containers, fabrics, etc. Can be removed by water scrubbing after decontamination operations, it is claimed.

No. 1616

For determination of arsenic in parts/billion amounts, stable reagent grade of silver diethyldithiocarbamate has been developed. With arsine, forms soluble red complex whose absorbance is proportional to concentration of arsenic over wide range and is easily measured. No. 1617

Two new radioactive carbon compounds, cortisone-4-C³¹ and cortisone-4-C³¹ accetate, now on market. These anti-inflammatorry, anti-ilergic, anti-libroplastic agents are used in advenal cortical insufficiency studies.

No. 1618

All existing information on sedium chloride has been compiled for the first time in a new, 752-page monograph now being sold. Brings together all modern data on salt sources, production, properties, uses.

PRODUCTS OF U.S.I

Ethyl Alcehel: Pure and all denatured formulas; Anhydrous and Regular Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL®M, ANSOL PR

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It's another Williams "first"—features not available in other hammer mills—that now makes it possible to maintain the original close clearances of both grinding plates AND cage sections against the rotating hammers. This easy-to-make "2-point" adjustment, in the most critical grinding area inside the hammer mill, gives absolute assurance of consistently uniform product quality.

In addition to the advantages of the Dual "2-Point" Adjustment, a Williams Reversible Hammer Mill substantially lowers upkeep expense by

cutting hammer cost. Hammers can be operated in one direction today and another tomorrow simply by installing a simple reversing switch on the driving motor. Manual reversing of hammers no longer necessary. Grate bars also last longer. The double set of reversible manganese breaker plates, which last twice as long as other types, give four times the service! Maintenance and downtime are cut 50% or more.

Get all the facts about the hammer mill with ALL the top features.

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Separators



Vibrating

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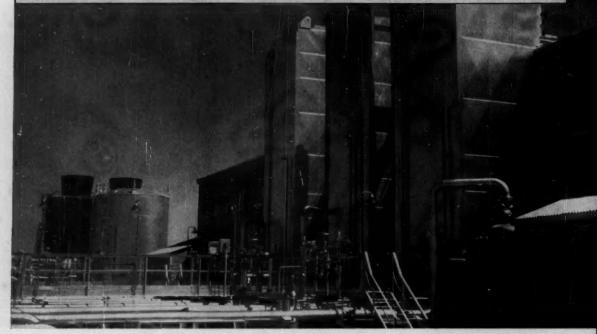


Oldest and Largest Manufacturers of Ha

DEVELOPMENTS ...

PROCESS FLOWSHEET

EDITED BY R. A. LABINE



BOXLIKE SEPARATION UNITS treat purified natural gas to yield a 75% helium, 25% nitrogen stream.

New Plant Counters Helium Shortage

The U.S. Bureau of Mines decisively, if temporarily, remedied a shortage last summer when it started operating its new 290-million-cu.ft./yr. plant at Keyes, Okla., for extracting high-purity helium from natural gas. With the new plant on stream, U.S. helium capacity is comfortably ahead of demand for the first time in several years.

The government has a vital interest in the helium supply-demand picture. Various federal users, in such areas as missiles, atomic energy, meteorology and aeronautical research, consume most of the light, inert gas. And to date the Bureau has been the sole producer of helium.

The new plant doesn't do away with helium supply problems for good. In the first place, the Bureau expects that requirements will overtake capacity again around 1963. But just as disquieting, it feels, is the lack of a program to conserve our total supply of helium, some of which vanishes with the wind every time a natural gas stream is burned.

► Enter Private Industry?—A solution for the conservation problem may be in the making. Congress is currently studying proposed legislation under which privately-owned firms would extract a crude (perhaps 75%) helium stream from natural gas. The Bureau would buy the crude material, store it, then refine and sell it to meet existing demand. Purchase price for crude helium and selling price for the refined product would pay out government investment in 25 years.

Big innovation in the suggested program is the proposal to buy crude helium from private firms. Up to now, private industry has shied away from the helium business; it has not cared to enter what it feels may be an uncertain market, particularly in competiton with the government. But the new legislation could make it attractive for companies to get into the crude helium busi-

Unfold Flowsheet



What It Costs to Make Helium

Keyes investment:

(including 15 permanent three-bedroom camp houses at plant site) \$11,000,000

Keyes design capacity:

(natural gas feed; 14.65 psia, 60 F.) 70,000,000 cu. ft./day

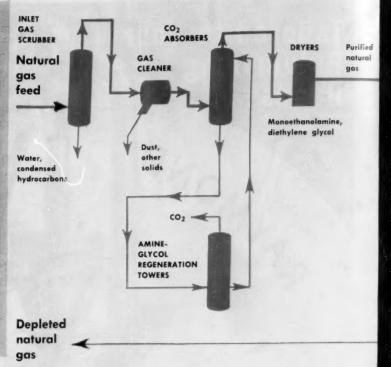
Approximate Keyes operating costs:

(based on Aug. 9-Dec. 1, 1959 operation) per M. cu. ft. helium @ 147 psia, 70 F.

Natur	al gas cost	.1	 1		\$3.60
Plant	operation		100		1.30
Plant	maintenance.			V	0.60
Plant	depreciation.				1.60
Plant	administration				0.30

Total \$7.40

NOTE: Above total dees not include: (1) Maintenance and depreciation on government tank cars for helium product—about 30.60 per M cu.ft. helium. (2) Residential housing costs—about 30.05 per M cu.ft. helium. (3) General administrative (U. S. Government) averhead—about 50.30 per M cu.ft. helium.



ness—if they can get a right price for the product. ► No Secrets—The new Keyes plant can serve the government as an eminent sales aid, since it furnishes an up-to-date illustration of helium technology and economics for private-industry entrants to the field.

With this in mind, the Bureau has not been reticent about revealing plant information. It maintains an open file in Washington, available to interested parties from private industry, which presents economic and other data for both the Keyes plant and the Bureau's older helium plant at Excell, Tex. The above table is based on some of these data.

The Bureau points out that its figures are intended only to provide general familiarity with helium processing. For one thing, factors such as helium content of natural gas feed will dictate design differences for different plants. And Keyes (as well as Excell) data are based on producing pure helium, while private plants would probably supply only crude helium.

Still, Keyes can provide a good preview since crude helium production is the heart of the Keyes operation; downstream purification of the crude mixture is only a minor part of the process.

▶ Borrowed Stream—The Keyes plant was engineered and built by Fluor Corp. It straddles a natural gas pipeline, originating in the Keyes gas field, which belongs to Colorado Interstate Gas Co. Plant takes gas from the pipeline, extracts helium,

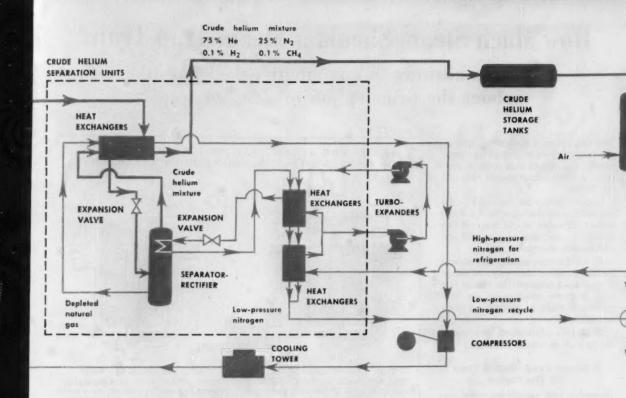
then returns the depleted stream to the line. Keyes-field gas contains 2% helium—an unusually high percentage—and the plant's extraction efficiency is 92-95%.

Annual helium production is about 290 million cu. ft. (1 atm., 70 F.). The plant could produce more, but is limited by the amount of natural gas that Colorado Interstate passes through its line. The flow is heavy in winter, lighter in summer.

Colorado Interstate receives a processing fee of 4ϕ for every thousand cubic feet of gas processed, plus 26ϕ per thousand cubic feet for gas consumed as plant fuel or in shrinkage.

These figures make up the natural gas cost shown in the attached economics table. All operating costs shown are based on production last fall, during a period when the facility made about 85 million cu, ft. helium. Since cost accounting began with initial plant startup, the unit costs may be higher than those experienced after the plant attained uniform process conditions.

▶ Purify Natural Gas—Pipeline gas enters the plant at 450-650 psi. It is first scrubbed to take out water and condensed hydrocarbons, then passed through a gas cleaner which removes pipeline dust and other solids. From the cleaner the gas goes to absorption towers, where CO₂ is removed by a solution of monoethanolamine and diethylene glycol. Preparation of the gas is then completed in dryers, where bauxite and molecular sieves lower water content to 0.000005%.



▶ Separate Helium—The purified gas is now ready for the crude helium separation step. Separation takes place in huge, boxlike units, 40 ft. high with a 10 x 10-ft. base, which operate in parallel. Designed and built by Air Products, Inc., they are reported to be considerably more efficient than the helium separation units used in older plants.

After entering one of the units, the gas is first chilled to -250 F. by heat exchange with exiting crude helium and depleted natural gas. The chilled stream is then throttled into a separator-rectifier chamber.

Helium, nitrogen and a small amount of hydrocarbons remain gaseous after this treatment. They rise to the top of the chamber where they are rectified by passing through shell-and-tube chillers with nitrogen as the cold-side fluid. After being rectified, the gas—about 75% helium, 25% nitrogen—helps chill incoming feed and then leaves the unit and goes to storage in horizontal tanks.

▶ Keeping Things Cold—The depleted natural gas collects as liquid at the bottom of the separator-rectifier. It passes through an expansion valve, helps chill incoming feed, then leaves the unit. It is compressed, cooled, and returned to Colorado Interstate's pipeline.

Each separation unit also contains most of the equipment which chills nitrogen for use as cold-side fluid in the shell-and-tube rectifiers. High-pressure nitrogen enters a separation unit and is partially chilled by exiting, expanded nitrogen. The

chilled stream is then split into two parts. One part cools further to about —290 F. by expanding in two centrifugal turbo-expanders located outside the separation-unit box, and this cold stream then helps chill the unexpanded portion of the original stream. Latter portion then passes through an expansion valve into the shell-and-tube rectifier.

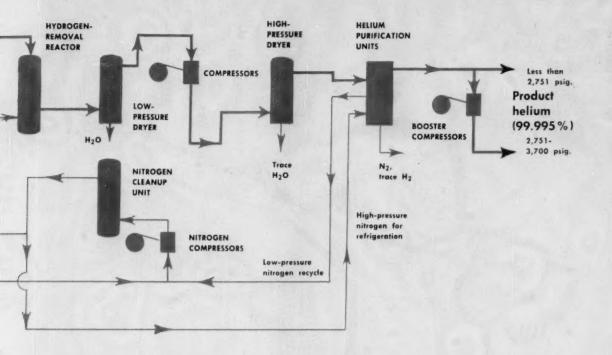
After chilling incoming nitrogen, the lowpressure streams from both the rectifier and the turbo-expanders leave the separation unit. Compressors and a clean-up unit prepare the nitrogen for re-use as refrigerant.

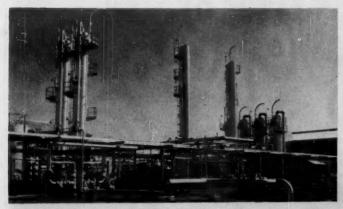
▶ Purify Crude Helium—First step in purifying the crude helium, stored in the horizontal tanks, is to remove hydrogen. Keyes does this by feeding the material to a reactor, along with a small amount of air, where the hydrogen is oxidized to water over platinum catalyst.

Gas from the reactor is then dried in two stages; the first stage is at low pressure and the second is at 2,750 psig.

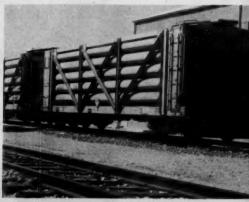
Final purification consists of first chilling the gas to liquefy most of the nitrogen, then removing last traces of nitrogen and hydrogen by passing the gas through adsorption beds of activated coconut charcoal.

The finished, 99.995%-pure product is shipped in specially-built tankcars, consisting of several small cylinders instead of the conventional single cylinder. This permits shipping at pressures as high as 3,700 psi.





GAS TREATING AREA removes carbon dioxide, water vapor from feed.



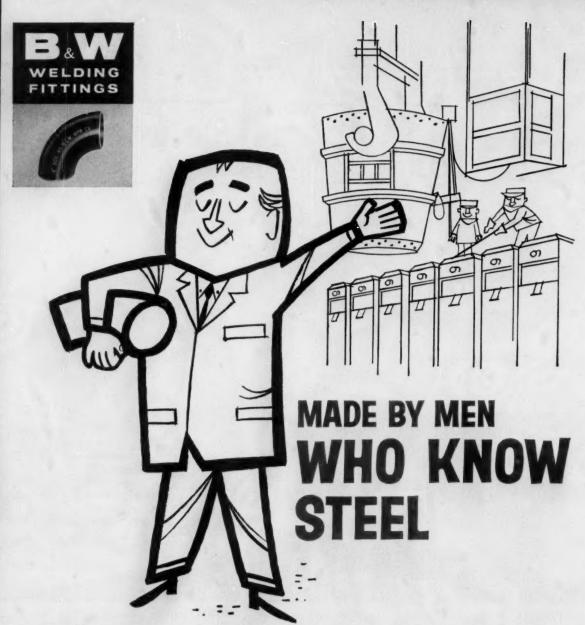
TANK CARS ship helium at high pressure.



PURIFICATION UNITS, left, yield final 99.995% helium product.



COMPRESSORS such as ones on right, above, recompress helium-depleted natural gas. Unit at left is one of three which compress nitrogen refrigerant.



B&W Welding Fittings manufacturing is integrated with the Division's own steel-making and tube-making facilities. Consider the relation between steel-making and the manufacture of welding fittings . . . B&W not only knows the complexities of fittings manufacturing, but also has an intimate knowledge of the making of the steels from which the fittings are formed. Integration plus knowledge naturally makes for a superior product. It enables B&W to provide a completely quality-controlled fitting, matched to

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How Much Steam Should a Steam Trap Trap?

... some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap all the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap all the steam but must remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: More efficient steam utilization, lower fuel costs.

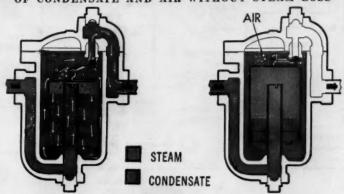
A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: Higher temperatures and better heat transfer in steam heated units.

A Steam Trap Should Remove Air and CO₂

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO₂ goes into solution to HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate. Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

form corrosive carbonic acid which, for example, can eat unit heater tubes. O₂ aggravates the situation. Believe it or not, but all traps don't properly remove air and CO₂.

By now, you've probably guessed that Armstrong traps do remove air and CO₂. Armstrong design (see illustration) provides continuous venting of air and CO₂. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap all the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

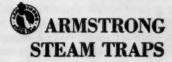
Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps... and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

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Write for Catalog No. 87 "Mill of a Thousand Uses" THIS compact grinding unit is one of the most versatile and economical mills in the Raymond line for medium size plants.

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The Imp Mill may be furnished with flash drying accessories for removing moisture while pulverizing, such as in drying and grinding ball clays direct from the pits, or in calcining gypsum for making wallboard.

If you have an unusual product that is difficult to process . . . the Imp Mill may be the answer to your problem. It provides a clean, dust-free, automatic system that cuts costs.

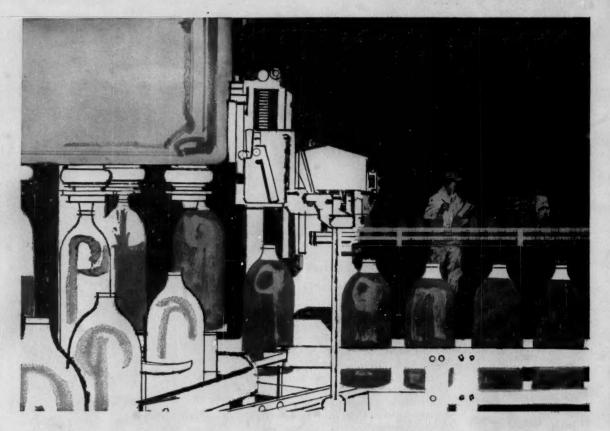
COMBUSTION ENGINEERING, INC. 1112 W. BLACKHAWK ST. SALES OFFICE IN

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Combustion Engineering-Superheater Ltd., Montreal, Canada

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Chemical processor licks costly bottle-filling problem

...WITH RYERTEX-OMICRON PVC

For years a processor of chlorine bleach made its own bottle-filling spigots from metal. But this proved to be a costly operation because the life of these spigots was limited since they did not completely resist the corrosive action of the bleach.

A switch to Ryertex*-Omicron PVC brought these money-saving results:

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2. ELIMINATION OF COSTLY REPAIRS AND DOWN TIME. Formerly, if a bottle wasn't centered perfectly, it was broken or chipped . . . or the guide jammed and the spigot bent. With PVC, bottle breakage and chip-

ping are eliminated. And if an off-center bottle jams the spigot or breaks it, replacement is simple and inexpensive.

3. INITIAL COST SAVING. Ryertex-Omicron PVC costs only pennies compared to the previous material. What's more, considering machining costs, the difference is even more impressive. The metal spigot required 11 hours of machining...PVC, 2 hours—a labor saving of more than 80%.

Perhaps amazing Ryertex-Omicron PVC can solve many problems for you—it resists 281 corrosive solutions and gases. Contact your Ryerson industrial plastics specialist for details.

TYPICAL APPLICATIONS

Tanks and tank linings, troughs, pipelines for liquids or gases, fume systems, blowers, roof ventilator housings, chutes, filter plates, splash covers, neutralizing acid equipment, settling and scrubbing towers...and many others.

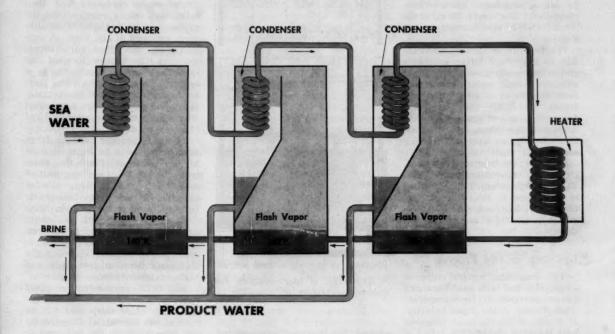


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Chemical Engineering

ULY 25, 1960



Rundown on Saline Water Conversion

Government pushes program to build five demonstration plants.

EDITORIAL STAFF

Will your fresh water supply run out by 1980? This is the date when the predicted water demand in this country will exceed the dependable natural fresh water supply-515 billion gpd. The solution to this shortage lies in tapping the limitless supply of sea water which surrounds us. Fortunately, the areas where the shortage is most acute are also the areas closest to the sea the east and west coasts and the southwest. Many of our most arid regions also contain great bodies of unused brackish water. The big question is, of course, how to convert these saline waters to fresh water at a reasonable cost.

To answer this question, Congress, in 1952, authorized the De-

partment of the Interior to establish an Office of Saline Water with a budget of \$500,000 to carry out a modest research and development program. The budget was later expanded to \$10,000,000. In 1958, a further \$10,000,000 was authorized to allow the OSW to build demonstration plants. Today, the OSW plans to build, in cooperation with several private firms, five plants throughout the country, demonstrating a different conversion process. Further legislation, still pending, would give OSW \$37,500,000 more to expand and continue its program beyond the present one which ends in 1963.

There is nothing new, of course, in the idea of fresh water from the

This roundup is based on three papers presented by the Process Industries Division at the Summer Annual Meeting, ASME, Dallas, Tex., June 5-9, 1960. Authors were: Allen Cywin, Office of Saline Water; Sheppard T. Powell and E. L. Knoedler, consuitants; H. R. Drew, Texas Electric Service Co.

sea-it has intrigued man for centuries. The first modern-day application was in steamships which carry multiple-effect evaporator systems to supply their boilers. The same process has operated for years in large land-based installations throughout the world-notably in Aruba (NWI) and Kuwait on the Persian Gulf.

What is new is the concerted effort to improve existing processes and to find new processes which will remove saline water conversion from the status of a high-cost last resort. The OSW has picked the five most advanced processes for its demonstration plants: multiple-effect long-tube vertical (LTV) evaporation: multistage flash (MF) distillation; electrodialysis; forcedcirculation vapor compression (FC-

tential and has been studied intensively by the OSW and private industry.

VC); and freezing. Each of these

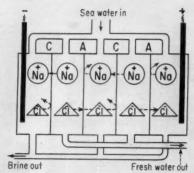
is considered to have low-cost po-

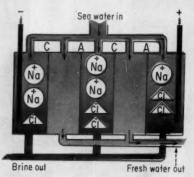
Updating an Old Process

The long-tube vertical type of evaporator has been used for many years-particularly to concentrate waste liquids in the paper industry. It is one of the cheapest forms of heat-transfer surface per dollar of installed cost and per unit of heat

In an LTV evaporator, the saline feed passes through long (30-35 ft.) vertical tubes where it is boiled by condensing water vapor or steam on the shell side. The feed then passes to a separator to remove the brine from the water vapor. In a multi-effect system, the sea water feed is preheated with the outgoing fresh water product and then enters the first effect where it is boiled by externally supplied steam. The water vapor produced enters the shell side of the second effect which is at a lower pressure than the first. Here, it condenses and boils the feed which is the liquor from the first effect. The condensed vapor is collected as fresh water product. The cycle repeats through the remaining effects, at progressively lower pressures and temperatures.

The main problems in conversion by evaporation have been scale formation and corrosion, both of which make it difficult to operate at higher temperatures. Scale formation can be prevented by acid-injection pH





SCHEMATIC of electrodialysis cell showing movement of ions-Fig. 1.

control, but this technique requires expensive corrosion-resistant alloys. A newer method, looked upon as a major breakthrough, is internal sludge stabilization. In this technique, seeds of the scale-forming material are introduced into the evaporating liquor, where the scale forms on the seeds rather than on the tubes. The seed suspension is easily maintained in an LTV evaporator because of the high velocity in the tubes.

The OSW demonstration plant for LTV evaporation, designed by W. L. Badger & Associates, will be built at Freeport, Tex. Contractor is Chicago Bridge & Iron Co. and the contract amount is \$1,246,250. Scheduled completion is the spring of 1961.

The 1,000,000 gpd. plant will have 12 effects, with a first-effect temperature of 250 F. and a finaleffect temperature of 110F. Steam will be supplied by Dow Chemical's nearby plant at 175 psi. and will be reduced to 30 psi. The new plant will demonstrate the internal sludge-control technique as well as feed deaeration and continued corrosion testing.

MF to Use Nuclear Power

A newer evaporation process is the multistage flash (MF) technique, shown in our lead illustration. Here, the seawater is preheated under pressure and then introduced into a vessel where the pressure is lower than the equilibrium pressure of the feed. A portion of the water flashes into vapor, lowering the temperature of the liquid. The vapor condenses in a condenser through which the feedwater is passing, and the remaining liquid passes to the next effect where the pressure is lower still and the cycle repeats.

The MF process permits large evaporator units to be built with higher efficiency than the older types, but at lower cost per unit of capacity. Present thinking calls for operation at less than atmospheric boiling temperature and chemical pretreatment to insure against scaling in the preheaters. It may, however, be possible to combine MF with LTV, using the sludge-stabilization technique and

higher temperatures.

The OSW demonstration plant for the MF process is being designed by Fluor Corp. and will be built at San Diego, Cal. Its capacity will also be 1,000,000 gpd. and it will have a large number of stages about 42. The plant is intended to operate at a feed temperature of 200F. but will be able to go higher (depending on new scale-control techniques). A new type nuclear reactor, designed by the Atomic Energy Commission exclusively for process steam production, will supply the energy for this plant. The reactor will feature aluminum- or steel-clad elements and will operate at a low pressure level (150 psig.). The OSW claims the reactor will be more economical than higher pressure power reactors and should prove more attractive than conventional steam generators in areas of high-cost fossil fuels. Seawater conversion plants are potential customers for large amounts of steam at low pressure which would be produced by these new reactors.

Conversion by Electrodialysis

A departure from evaporation is electrodialysis where the salt is taken from the water instead of the water from the salt. An electrodialysis cell consists of an anode

and a cathode between which are spaced a series of semi-permeable membranes. The membranes are alternately composed of anion-exchange and cation-exchange material. With a voltage applied to the electrodes, the seawater (or brackish water) enters one end of the cell. Fig. 1 shows how the anions are attracted to the anode and the cations to the cathode but are confined to alternate compartments by the membranes. Thus, at the other end of the cell, alternate streams of high and low concentrations emerge. Suitable manifolds separate the streams into product and waste.

The major difficulties with this process have been hydraulic problems and short membrane life. Obviously, to keep cell resistance as low as possible, it is necessary to place the membranes as close together as practicable (0.5-1mm). If this is done, however, the problem of achieving uniform water flow and distribution over the surface of the membranes is compounded. A balance must be struck between these two conditions.

There are two types of membrane—homogeneous and heterogeneous. The first consists entirely of ion exchange material and the problem is to build sufficient strength into the membrane for a reasonable life. A heterogeneous membrane is reinforced with woven glass or woven synthetic fibers. Unfortunately, the membranes so far developed with

the best strength and selectivity and the lowest electrical resistance have also been the most expensive.

The power requirements of this process, unlike evaporation, vary directly with the desired difference in concentration between the feed and the product. For this reason, electrodialysis is more attractive economically when applied to brackish waters (salinity 1,000 ppm.—17,000 ppm.) than when applied to sea water (35,000 ppm.).

The OSW will build its electrodialysis demonstration plant at Webster, S. D. The plant, designed by the Bureau of Reclamation, will produce 250,000 gpd. of water with a concentration of 500 ppm. Feed will be 350,000 gpd. of 1,500 ppm. brackish water. Two stacks of cells will form the heart of the plant—the cells in parallel and the stacks in series. Other features will be filtration and clarification of the feed as well as acid-injection pH control to prevent scale formation in the cells.

A plant of this size, designed by Ionics, Inc., is already operating at Oxnard, Calif. The cost of treatment is claimed to be 20¢ per 1,000 gal.—a startlingly low figure. The feed, however, has a mineral content of only 1,300 ppm. while the product is 800 ppm. Ionics has designed and built several other plants of smaller capacity. In Texas, where brackish water is common, the Texas Electric Service Co. has sponsored extensive re-

search and development on electrodialysis and has developed a 40-ft. cell suitable for stacking.

Uses Less Fuel

The FC-VC process is an outgrowth of the small distillation units used by the military in World War II. Although the equipment is complex, the cycle is simple, see Fig. 2.

Salt water is boiled in a tubular heat exchanger, part vaporizes, then is heated by mechanical compression. The vapor then condenses in the evaporator-condenser, boiling an equal amount of salt water again. The cycle repeats, with the distillate and brine being discharged through an exchanger which preheats the feed.

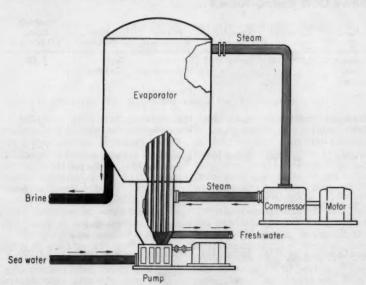
The costs of this process vary inversely with the temperature of evaporation—that is, the higher the temperature, the smaller the heat exchange surface and compressor. At high temperatures, however, scale formation increases. A method of increasing heat transfer and decreasing scale formation is forced circulation of the feed. Dropwise condensation on the vapor side would also increase heat-transfer rates.

The fourth OSW plant, at Roswell, N. M., will demonstrate the FC-VC cycle and will also allow experiments on dropwise condensation. Capacity of the installation will be 250,000 gpd. The plant will have an axial-flow type compressor which is expected to be much cheaper than a positive-displacement type of similar capacity. Scale control will be by acid injection and frequent blowdown. The OSW hopes the plant will be able to operate at 212 F.

Freezing Out the Water

The fifth and final plant of the present demonstration program will be based on the simple idea of freezing the water and removing it from the brine. Two methods for accomplishing this separation have been proposed—freeze-evaporation and direct-refrigerant cooling.

In the first method, sea water is introduced to a high-vacuum chamber, where it flash cools to a temperature low enough to produce ice crystals. The water vapor passes off overhead where the vacuum is



SCHEMATIC of a forced-circulation vapor-compression plant-Fig. 2.

maintained either by mechanically compressing the vapor or by absorbing it in a concentrated solution of LiBr. The ice-brine slurry is drawn off the bottom of the vacuum chamber and passes into a wash column. Here, the ice crystals are washed with a counter-current flow of fresh water to remove salt and brine. The ice crystals leave the top of the column and enter a melter where they are melted by fresh water warmed by condensation at the vacuum chamber.

The direct-refrigerant process, a development of Cornell's H. F. Wiegandt and Blaw-Knox Co., freezes the water by evaporating a refrigerant, such as isobutane, directly in the brine. The resulting ice-brine slurry passes through a washer where the ice is washed and separated. The ice enters a melter where it is melted by refrigerant vapors which have been collected and compressed at the freezer. See Chem. Eng., June 13, 1960, pp. 152-155, for a detailed description of the two freeze processes, complete with flow sheets.

Both freezing processes encounter the most trouble in the crystal-washing step. The small size of the crystals and their wafer shape, together with the viscosity of the cold adhering brine, make economical separation very difficult.

Plans for the freeze-demonstration plant are least advanced of the five. Although the plant will be located on the east coast. exact site has not been picked. Capacity will likely be 100,000-350,000 gpd. Three process designers are still competing for the job: the Carrier Corp. has a 15,000 gpd. freeze-evaporation pilot unit; Blaw-Knox is building a 35,000 gpd. direct-refrigerant unit; latest entry is a process jointly developed by Scientific Design and Struthers-Wells which produces large, more easily washed crystals (Chem. Eng., June 27, 1960, p. 55).

The OSW has more processes still up its sleeve. The newest, still in the lab, is the hydrocarbon-hydrate process. Here, a hydrocarbon gas—propane, for example—is mixed with the sea water under pressure—about 50 psig. for propane. The gas forms a hydrate with the water, similar to ice, which is washed free of salt and brine and then exposed to atmospheric pressure. The gas flashes off to recycle, leaving fresh water.

Solvent extraction and solar distillation are still in the running. Solar distillation, however, appears to be out as a large scale process because of the huge surface area required per unit of product.

Today, the largest operating

saline water conversion plant in the world, on the island of Aruba, produces fresh water at a cost of about \$1.75/1,000 gal., compared with about \$0.35 for the average fresh water supply in the U.S.A. The OSW hopes to approach \$1.00/ 1,000 gal. with its demonstration plants by virtue of its new processes and techniques. To break the \$1.00 barrier, however, the problem must be looked at from different angles. One promising possibility is to dilute high-purity water from the evaporation processes with saline water to produce 900-1,000 ppm. water-good enough for most purposes. To reduce the fuel-cost factor, water-conversion plants could be combined with power plants. The water plant would operate on low-pressure steam expanded through a turbine producing electricity.

Capital costs can be reduced in two ways—cheaper materials or smaller equipment size.

The OSW does not expect that any one of its processes will prove to be better than all the others at all locations. Local conditions, such as fuel costs and salinity of the feed water, will determine the optimum plant. OSW expects, too, that when saline water conversion is in large scale use, costs will have been reduced to about \$0.50/1,000 gal.

Present Status and Comparison of Five OSW Plants—Table I

Process	Design Contractor	Plant Site	Capacity, Gpd.	Scheduled Completion	Process Advantages	Main Problems	Predicted Costs, \$/1,000 gal.
Long-tube vertical evap.	W. L. Badger & Assoc.	Freeport, Tex.	1,000,000	Spring 1961	Low-cost High tempera- ture Good heat transfer	Scale Corrosion	1.00
Multistage flash	Fluor Corp.	San Diego, Calif.	1,000,000	Spring 1961	High efficiency Low capital cost	Scale Corrosion	1.20
Electro- dialysis	Bureau of Reclamation	Webster, S. D.	250,000	Spring 1962	Low-cost for brackish water	High mem- brane cost	1.00
Vapor compression	One of: Mechanical Equip Co. Maxim Sflencer Co.	Roswell, N. M.	250,000	Spring 1962	Low fuel input	Scale	1.10
	Cleaver-Brooks Co. Griscom-Russell Co.				Compact	Complex operation	
Freezing	One of: Carrier Corp. Blaw-Knox Co. Scientific Design and Struthers-Wells	East Coast (not chosen)	100,000- 350,000	Spring 1962	Avoids scale and corrosion	ice-crystal separation	1.00



How to Design a Pressure Relief System

Adequate relief devices but undersized headers can be disastrous—proper design can help ensure the safety of your plant. Here is a new approach.

JOSEPH CONISON, The Ralph M. Parsons Co., Los Angeles, Calif.

A vapor relief system may be only one relief valve or rupture disk on a single vessel, or it may be one of the more complex piping systems in the plant involving many relief valves manifolded into a common header. Such systems are indispensable components of any plant with processes in closed vessels, be they high or low pressure.

But any pressure relief system is only as good as any of its parts. Adequate valves manifolded into inadequate piping produce a poor system since pressure drop in the lines can prevent quick relief of the pressure in the vessel. Thus it is not enough to pick a valve suited to the job; you must also size the laterals and the common header so that they can bear the full load from wide open relief valves without excessive pressure drop which can reduce line capacity.

Without exaggeration, then, we can say that proper design of a vapor relief system is one of the most important problems of good plant design because upon this system rests safety of personnel and protection of equipment and product. The consequences of poor de-

sign can be expensive, if not disastrous.

Some Design Parameters

A relief system designer must consider several factors when designing the laterals and the common header. These are:

1. The ASME Code1.

2. Relief valve operating characteristics and capacities.

3. Design pressure of the operating equipment associated with the relief valves.

4. Line capacities and lengths:

5. Physical properties of the vapor to be relieved.

The ASME Code is a safety guide for the processing industries. It establishes regulations for safe practice in design, construction, inspection and repair of unfired pressure vessels handling petroleum and other hazardous liquids and vapors.

In accordance with the ASME Code, all unfired pressure vessels, other than unfired steam generators, shall be protected by pressure relieving devices that will prevent the pressure in the vessel from rising 10% above the maximum allowable working pressure, except when the excess pressure is caused by fire or other unexpected source of heat. In the event of overpressure from the latter, the pressure relieving devices shall be capable of preventing the pressure from rising more than 20% above the maximum allowable working pressure when all pressure relieving devices are blowing.

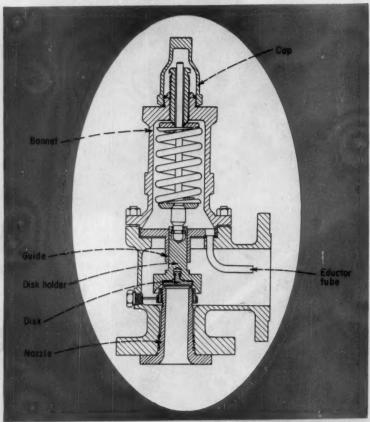
Size of the outlet pipe shall be such that any pressure that may exist or develop in the discharge line will not reduce the relieving capacity of the safety devices below the amount required to protect the vessel from overpressure.

A Word About Valves

Size of the relief valve is dependent upon the pressure differential across the valve plus the allowable per cent of accumulation. The maximum back-pressure built up or developed in the relief header system from friction losses determines the type of valve used, standard or balanced. Friction loss allowed in the relief system determines the diameter of the pipe.

General practice in the industry is to select relief valves that start relieving at the design pressure (design pressure will be interpreted as the maximum allowable working pressure) of the vessel and reach full capacity at 3 to 10% above the design pressure. In other words, the valve will start to open at the vessel design pressure and will reach its fully open position at 3 to 10% above the design pressure. This overpressure is generally termed "Accumulation," and is based upon the per cent pressure rise from the time the valve begins to open to when it is fully open.

Nozzle type relief valves are available today in the "Standard"



STANDARD relief valve set-pressure is affected by line pressure which adds to that of the spring and thereby raises the relieving pressure.—Fig. 1.

or "Balanced Bellows" configurations (Figs. 1 and 2). For a complete discussion of the different types available, read ASME Paper No. 51-8A-18².

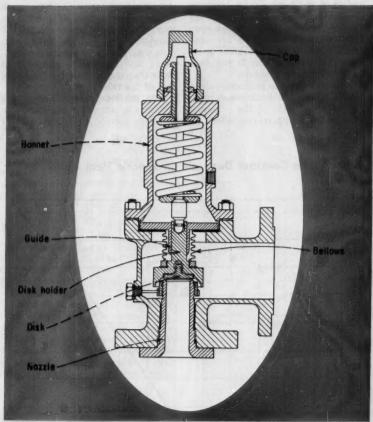
Back pressure in the downstream piping affects the "Standard" type valve (Fig. 1). In the disk type, if the guide is vented and the bonnet plugged, the relieving pressure of the valve will increase linearly with increase in back pressure. Take, for example, a relief valve that is designed to open initially at 100 psig. with a 100 psi. differential and 10% accumulation. If the back pressure rises to 10 psig., the valve will begin to open at 100 psig. and relieve its maximum design capacity at 120 psig. If the vessel is designed for 100 psig., the ASME code will have been violated by permitting the internal vessel pressure to rise 20 psi., or 20%, above the vessel design pressure, even though

the valve was originally set to open at the vessel design pressure.

On the other hand, if the guide is plugged and the bonnet vented, the relieving pressure of the valve will decrease with increase in back pressure. This arrangement causes the valve to relieve in all cases below the initial set pressure. Many process industries use this type of valve plugging when more than one valve is manifolded into a common exhaust because if the back pressure rises above atmospheric, losing some of the product out the vent is preferable to jeopardizing the equipment. However, process upsets may be created in areas other than the one in which the vessel or vessels are relieving.

Hazards of Manifolding

Consider that three vessels, A, B and C, are relieving to a common



BELLOWS valve isolates bonnet from pressure in the line and therefore maintains preset balance between valve spring and vessel pressure—Fig. 2.

system. Their escaping vapors create a back pressure in the system. If a relief valve on vessel D is of the type mentioned above and vessel D is far removed from, and not associated in the process with vessels A, B and C, a back pressure in the relieving header may cause it to open. Opening the relief valve on vessel D below the set pressure may change the normal operating pressure in the vessel, thereby creating an operating upset if the pressure in the vessel is above or below the header pressure.

Back pressure built up in the relief header theoretically would not affect the set pressure on a "Balanced" type valve (Fig. 2). However, due to imperfections in manufacture and limitations to practical design, the balanced valves available today will vary in relieving pressure when the back pressure reaches approximately 40% of the

set pressure, depending on the manufacturer.

The gain obtained in permitted back pressure design may be the difference in many header systems between one, two or more pipe sizes.

Calculate Valve Capacity

Vapor relieving capacities for both types of relief valves are limited by the following formula:

$$W = CKAp_a \sqrt{\frac{M}{ZT}}$$
 (1)

where:

$$p_a = P\left(1 + \frac{\% \text{ Accumulation}}{100}\right) + 14.7$$

The factor C is dependent upon k, the ratio of the specific heats, and may be obtained from Fig. 3. Where k is not known, you may use the conservative value of k = 1.001.

At this value of k, C=315. If K=0.97, then $CK=315\times0.97=306$. This value is commonly used by the API (American Petroleum Institute) and the ASME.

Eq. (1) is based on the assumption that critical flow occurs through the orifice of the valve. This condition exists when the outlet pressure of the valve is never above 50 to 60% of the absolute inlet pressure; or, precisely, when the outlet pressure does not exceed p_i where:

$$p_1 = p\left(\frac{2}{k+1}\right)^{\frac{k}{k-1}} \tag{2}$$

As long as the back pressure does not rise above p_1 in Eq. (2), critical conditions will prevail and critical flow will occur through the valve.

As an example, assume that the critical pressure, p_i , on the outlet of a specific relief valve is 50 psia. and the relieving inlet pressure, p_i is 100 psia. Then, as long as the back pressure in the header does not rise above 50 psia., critical flow will occur across the valve. If the back pressure rises above 50 psia., the flow rate will diminish.

For general purpose calculations under non-critical flow conditions, the correction factor K_{bp} , should be applied to Eq. (1). Fig. 4 gives the correction factor K_{bp} versus p_1/p where p_1/p is the ratio of absolute valve outlet pressure to absolute inlet pressure.

For more accurate calculations, we recommend the following formula:

 $W = (735 \, A \, pC) \, \times$

$$\left[\frac{M}{T} \left(\frac{k}{k-1}\right) \left(\frac{p_1}{p}\right)^{\frac{2}{k}}\right]^{\frac{1}{2}} \times (3)$$

$$\left[1 - \left(\frac{p_1}{p}\right)^{\frac{k-1}{k}}\right]^{\frac{1}{2}}$$

For practical purposes the absolute temperature at the valve outlet, T_1 , can be calculated under critical flow conditions from Eq. (4) below:

$$T_1 = T\left(\frac{p_1}{p}\right)^{\frac{k-1}{k}}$$

$$= T\left(\frac{2}{k+1}\right) \tag{4}$$

Factors in Line Sizing

When determining the proper sizes for the main header and the laterals, you must consider the following factors, some of which we mentioned previously:

 Maximum vapor relieving capacity required for design purposes.

2. Maximum back pressure that can be tolerated in the header sys-

3. Type of relief valve or valves to be used.

4. Governing code.

After you have established the above items, selection of the right line size reduces to fluid flow calculations.

Maximum design capacity is generally based on the group of valves that may vent the maximum amount of vapor at one time. This condition may be attributed to process or fire, whichever governs in establishing maximum flow.

Process selection depends on process variables, such as cooling water failure or a control valve failure.

Fire selection is generally based on the number of vessels in an area that may be subjected to the same fire. Radius of the fire zone may vary from 30 to 60 ft. depending on set plant policy or experience or both. In general, the plot plan layout is used and the vessels are grouped by zones in a logical manner.

Maximum back pressure permitted in a header system is invariably based on the lowest design pressure vessel, type of valves and governing code.

Raise Allowable Pressure

One method for increasing permitted back pressure, when standard valves are used, is to lower the setting of the valve below the vessel design pressure. For example: assume the design pressure of the vessel is 50 psig. and the normal operating pressure is in the range of 5 psig. The relief valve may be set to open in this case at 30 psig., but designed for full rated capacity at 55 psig. (which is equal to 50 + $(10\% \times 50)$. This arrangement will now tolerate a back pressure of 20 psig. as against 5 psig. with the valve set at 50 psig. with 10% accumulation. Consequently, we may design the relief header for smaller diameter pipe and use the same size valve as the one set for 50 psig.

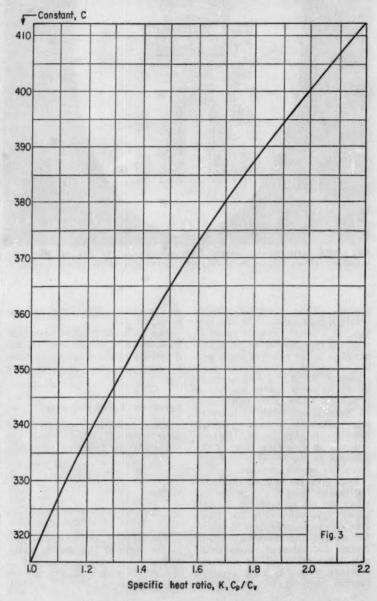
Another method for increasing the allowable back pressure with standard valves is the procedure mentioned earlier—plug the guide and vent the bonnet. An increase in back pressure will lower the relieving pressure and will not over pressure the vessel. This arrangement, however, can uset the process if the valve setting is too close to the operating pressure.

You can also use balanced valves which permit the back pressure to rise to about 40% of the set pressure without appreciable effect on

the relieving capacity and pressure of the system. Cost of the valves may be slightly more than the standard type, but the savings in pipe cost plus the operating advantages and flexibility gained will more than compensate for the added cost of the valves.

You might consider having two separate systems for high and low pressure service. Even though this

Relief Valve Constant Depends on Specific Heat Ratio



arrangement will involve two headers, the cost may be less in some cases since you will be able to divide the vapors rather than having one common system limited by a low-pressure vessel.

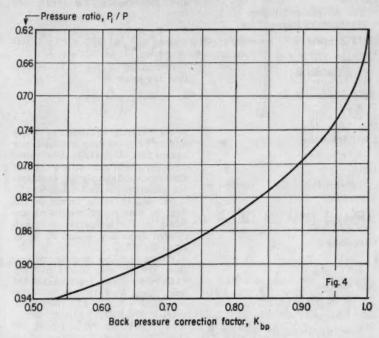
Calculate Line Capacity

Maximum carrying capacity of any line is limited by the acoustic (or sonic) velocity at the outlet of the pipe which may establish the outlet pressure. The equation developed by Crockers for finding the maximum pipe capacity for flowing gases and vapors is:

$$p_{i} = \frac{W/d^{3} \sqrt{\frac{RT_{1}}{k(k+1)}}}{11,400}$$
 (5)

We can use Eq. (5) to determine the outlet pressure of the pipe with the quantity W flowing. If the vapors are discharging to atmosphere, then the outlet pressure of the pipe must be equal to or greater than atmospheric pressure. If p, calculated is less than atmosphere then the outlet pressure equals atmosphere. If p, calculated equals atmosphere, any increase in W will increase the discharge pressure at

For Non-Critical Flow, Use Correction Factor, K_{bp}



Nomenclature

- Nozzle throat area.
- Constant based on k (see Fig. 3).
- C_{ν} Specific heat at constant pres-
- C.Specific heat at constant volume.
- Pipe internal diameter, ft.
- Pipe internal diameter, in.
- d Friction factor.
- Gravity, 32.2 ft./sec.3
- Valve discharge coefficient, generally 0.97.
- K_{bp} Backpressure correction factor,
- from Fig. 4 for use in Eq. 1.
- Ratio of specific heats, C_p/C_v .
- Length of pipe.
- M Average molecular weight of gas or vapor.
- Pressure, gage.
- Pressure, absolute.
- p. Accumulated inlet pressure, absolute.
- RTV Gas constant, 1,545/M.
- Temperature, °R.
- Velocity.
- Specific volume. v W
- Gas or vapor flow, weight per unit time.
- Z Compressibility factor.
- Density of gas or vapor.

Subscripts

- None Valve inlet conditions.
- Valve outlet conditions. Line terminus conditions.

the pipe outlet. If p, calculated is greater than atmosphere, it must be added to the friction loss calculated from the relief valve outlet to the outlet of the header to determine the total back pressure at the relief valve.

For example, suppose we want to relieve 95,270 lb./hr., W, of a vapor whose molecular weight, M, is 44 through a relief header. Outlet temperature, T1, of the valve is 690 R. and k of the vapor is 1.3.

What is p_i , the outlet pressure of the header?

First, assume a pipe diameter, d, of 12 in. Then, referring to Eq. (5), plug in the appropriate numbers and solve for p_i :

$$p_i = \frac{95,270}{144} \sqrt{\frac{1,545}{44}} \times \frac{690}{1.3(1.3+1)}$$

$$p_i = 5.2 \text{ psia.}$$

Now, p, as determined here is the outlet pressure of the pipe if it is discharging to vacuum. But, since it is not discharging to vaccum but to the atmosphere, p, cannot be less than atmospheric and thus becomes

Note that P, is independent of the length of pipe. Within limits and assuming constant temperature, P, will be the same whether the pipe is 10 ft. or 1,000 ft. long. What will change, however, is P_{i} , the pressure at the valve outlet, and the pressure at all points between P_1 and P_4 .

Thus we must determine the pressure drop in the line working backward from P, to P, to find the back pressure at the valve.

A New Approach

Equations available for calculation of pressure drop in compressible fluids, where velocity is less than acoustic and where pressure, velocity and specific volume are constantly changing, are generally tedious. Also, the equations are invariably in terms of initial conditions at the outlet of the valve, which at the start of this type of calculation are unknown.

To simplify the calculations, we have derived an equation for obtaining the pressure drop based on known terms of the header outlet conditions and assuming constant temperature of the flowing fluid in

The derivation follows:

At constant temperature:

$$P_1 v_1 = P_i v_i = RT = \text{Constant}$$
 (6) and:

$$\frac{V_1}{V_I} = \frac{v_1}{v_I}$$

Square both sides:

$$\frac{V_{1^{2}}}{V_{t^{2}}} = \frac{v_{1^{2}}}{v_{t^{2}}}$$

Clear fractions:

$$V_{1}^{2} v_{t}^{2} = V_{t}^{2} v_{1}^{2}$$

But:

$$P_1 v_1 = P_t v_t \qquad \text{from Eq. (6)}$$

Therefore:

$$\frac{P_1 \, v_1}{v_1^2 \, V_t^2} = \frac{P_t \, v_t}{V_1^2 \, v_t^2}$$

Cancelling:

$$\frac{P_1}{v_1 \ V_t^2} = \frac{P_t}{v_t \ V_1^2}$$

And we get:

$$\frac{v_1}{V_{i^2}} = \frac{P_1 \, v_t}{V_{i^2} \, P_i} \tag{7}$$

Now we refer to the general energy equation:

$$vdP + \frac{V_1 dV}{a} + \frac{fV_1^2}{2aD} dl = 0$$
 (8)

Then, if we multiply Eq. 8 by $2g/V_1^2$, we have:

$$\frac{2gv}{V_1^2} dP + \frac{2dV}{V_1} + \frac{fdl}{D} = 0 (9)$$

If we substitute Eq. (7) in Eq.

$$0 = \frac{2gv_t}{V_t^2 P_t} \int_1^t P dP + 2 \int_1^t \frac{dV}{V} + \frac{f}{D} \int_1^t dl \quad (10)$$

$$0 = \left[\left(\frac{2gv_t}{V_t^2 P_t} \right) \left(\frac{P_t^2 - P_1^2}{2} \right) \right] + (2 \log_e V_t / V_1) + \frac{fl}{D}$$
 (11)

In cases where line lengths are approximately 100 ft. or more, or where the velocity change is small, the term $(2\log_{1} V_{1}/V_{1})$ can be ignored without appreciable error so that Eq. (11) reduces to:

$$P_{t^{2}} - P_{1^{2}} = -\frac{(fl) (V_{t^{2}} P_{t})}{Dgv_{t}}$$

$$P_{i}^{2} = P_{i}^{2} + \frac{(fl) (V_{i}^{3} P_{i})}{Dgv_{t}}$$
 (12)

Substituting density, ρ , for $1/v_i$ and rearranging Eq. (12), we

t constant temperature:

$$P_1 v_1 = P_t v_t = RT = \text{Constant} \quad (6) \quad P_1 = \left[\left(\frac{f(\rho_t V_t^2)}{2gD} \right) (2P_t) + P_t^3 \right]^{\frac{1}{3}} \quad (13)$$

Inspection of Eq. (13) reveals that the quantity

$$\left(\frac{fl\rho_t V_{t^3}}{2gD}\right)$$

is the Fanning equation for determining pressure drop in pounds per square foot. It is easily determined with the aid of conventional charts that are available in all engineering departments and handbooks.

All gas or vapor terms in the final or pipe outlet conditions are based on the temperature T1 calculated from Eq. 4 and P_i or p_i from Eq. (5).

Where the line lengths are less than 100 ft., you should use Eq. (14) below which incorporates the term $(2\log_e V_i/V_i)$:

$$P_{1}^{3} = P_{i}^{3} \left(\frac{f l \rho_{t} V_{i}^{2}}{g D} \right) + P_{i}^{3} + \frac{2 V_{i}^{2} \rho_{t} P_{t}}{g} \log_{\epsilon} \frac{V_{t}}{V_{1}}$$
(14)

Another common method for obtaining pressure drop in pressure relief systems applies the Fanning flow equation at constant temperature. In this method, you start at the terminus and calculate increments of pressure drop back to the relief valve. The maximum pressure drop increment is limited to 10% of the average pressure.

Built-in Safety Factor

Our constant temperature approach provides a safety factor. Actually, the vapor temperature along the header would be less than the temperature at the valve because the vapor will lose heat through expansion, conduction and radiation. The degree of cooling depends on climatic and atmospheric conditions.

Since assumption of constant temperature throughout the line also assumes a higher pressure and back pressure in the line than would actually be the case, our approach will yield a somewhat larger pipe than is actually needed-a built-in safety factor. However, since it is difficult or impossible to know the heat loss variables with any degree of accuracy, we feel that a slightly larger but conservatively calculated line will compensate for engineering assumptions and theory that do not always follow in practice.

ACKNOWLEDGMENT

I wish to thank the management of the Ralph M. Parsons Co. for permission to publish this paper. I am especially grateful to Messrs. William Carmack and William Lanz for their assistance.

I am also appreciative of the acceptance of the method proposed in this paper by the API Subcommittee on Pressure Relieving Systems.

REFERENCES

1. ASME Boiler and Pressure Vessel Code Section VIII, American Seciety of Mechanical Engineers, New York, 1959.
2. Chesler, S., and B. W. Jesser, "Some Aspects of the Design and Economic Problems Involved in the Safe Disposal of Inflammable Vapors from Safety Relief Valves," ASME Paper No. 51-8A-18, 1951. Sylvander, N. E., and D. L. Katz, "The Design and Construction of Pressure Relieving Systems," Univ. of Michigan Press, Ann Arbor, Mich. (1948).
4. American Petroleum Institute Report No. 529, New York, Sept., 1955.
5. Crocker, Sabin, and J. H. Walker, "Piping Handbook," p. 260, 4th Ed., McGraw-Hill, New York (1945).



JOSEPH CONISON appears in our pages for the second time. He was the author of "Assure Full Range Flow Control" in our Dec. 1, 1958, issue.

Mr. Conison is now Supervisor of Instrument Engineers in Parsons' Petroleum-Chemical and Architect-Engineering Divisions at Los Angeles where he has been since 1957. Previously, he spent ten years as project, process and instrument engineer with Fluor Corp.

Our author received his B.Ch.E. from the University of Cincinnati in 1941. He is an honorary member of Mu Pi Kappa, chairman of the Southern California Meter Association, executive committee member of the Instruments and Regulators Div. of ASME and a member of ISA.

A SIX-ARTICLE SERIES ON LOW-TEMPERATURE CONSTRUCTION MATERIALS

CARBON STEELS
ALLOY STEELS
STAINLESS STEEL
NICKEL ALLOYS
ALUMINUM
COPPER

Nickel Steel Alloys

For Liquids at -320 F., 9% Excels.

R. J. JOHNSON, The International Nickel Co., Inc., New York, N. Y.

This is the fourth of seven articles we are publishing on construction materials for low-temperature service, from subzero to the absolute zero. Later articles, to appear in subsequent issues, will cover aluminum and copper and will also include a critique from a major designer of low-temperature process plants.—Editor

Low-carbon 9% nickel steel is a ferritic alloy developed to supply a moderately priced steel for liquefied gas storage and regenerator equipment operating at temperatures as low as -320F. Activity in this field is now accelerating as the demand for tonnage oxygen in steel making, ore roasting and missile propulsion increases. Marine transportation of liquefied-gas fuels is also advancing, and a prototype ship already delivers liquid methane at -260F. to the United Kingdom. From their experience with this prototype, designers will build tankers specifically for liquid methane transport. These tankers and their land-based storage facilities should be large consumers of 9% nickel steel because of its moderate cost and good low-temperature properties.

ASTM specifications A-300 and A-353 cover low-carbon 9% nickel steel—A-300 being the basic specification for low-temperature ferritic steels. ASTM nickel steel specifications require that the steels withstand 15 ft.-lb. in the keyhole-

notch Charpy impact test at a minimum temperature. A-353, for 9% nickel, sets this at -320F.

Specification A-353-58T covers two grades of 9% nickel steel with the compositions shown in Table I.

The heat treatment recommended

is double normalizing at 1,650F. and 1,450F. followed by tempering or stress relieving at 1,050F. for at least 2 hr. Tensile properties (flat specimens to ASTM A-20) required for plate treated in this manner also appear in Table I.

ASTM Specifications for 9% Nickel Steel—Table I

+	Composition	+	→ Ter	sile Properti	os +
	ASTM A-353 Grade A	ASTM A-353 Grade B		ASTM A-353 Grade A	ASTM A-353 Grade B
C, max. %	0.13	0.13	Tensile streng	th, 90,000	95,000
Mn, max. %	0.80	0.90	Yield strength,	,0,000	,0,000
P, max. %	0.035	0.035	(0.2% offset)		
S, max. %	0.040	0.040	min. psi	60,000	65,000
Si, %	0.15-0.30	0.15-0.30	Elongation in 2 in., min. %	22	20
Ni. %	8.50-9.50	8.50-9.50	4 m, mm, 70	44	20

Thermal Properties of 9% Nickel Steel—Table II

Temp., °F.	Coef. Thermal Expansion 10 ⁻⁶ In./(In.)(°F.)	Temp., °F.	Thermal Cond. Btu. per Hr., Sq. Ft., °F. and In.
At 75	5.8	+ 80	203
-300 to 0	5.3 (avg.)	- 9	190
-300 to +200	5.6 (avg.)	-100	172
At -300	4.0	150	169
		-190	149
Temp. range, °F.	+80 to -320	-240	134
Avg. sp. ht., 8tu./(lb.)(°F.)	0.0878	-320	91

Tentile values obtained over a range of temperatures down to -320F. for properly treated plate are shown in Fig. 1.

Table II shows thermal properties of 9% nickel steel to be used for design calculations.

Section VIII, Table UCS-23 of the ASME Unfired Pressure Vessel Code, allows the following design stresses for 9% nickel steel:

Temp., °F. Design Stress, Psi. SA-353A SA-353B -20 to 650 22,500 23,750

These values also apply for temperatures below -20F. The design stress for A-353 Grade B is determined from Section VIII, Paragraph UA-500.

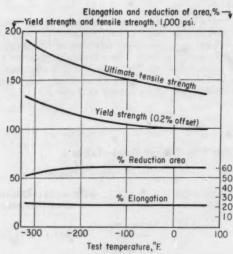
Plate Impact Properties

Over the years, a number of tests on specimens from plate which was rolled from commercial melts have established the characteristic impact behavior at low temperatures. Fig. 2 shows the scatter-bands for V-notch and keyhole-notch Charpy tests made on plates to 1-in. thick. Specimens cooled to -440F, in liquid helium produced Charpy Vnotch values from 13 to 18 ft.-lb. Keyhole-notch Charpy values were 15 to 22 ft.-lb., showing a considerable margin over ASTM A-300 which specifies a minimum of 15 ft.-lb. Charpy keyhole-notch at -320F.

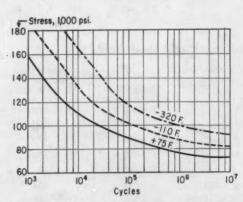
In addition to the Charpy test,

the U. S. Naval Research Laboratory has developed a drop-weight test to evaluate low-temperature steels. Drop-weight tests on ½-in. and 1-in. 9% nickel steel plate did not propagate fracture at temperatures as low as -320F., indicating that the nil ductility transition (NDT) is below this temperature. NDT is the temperature above which a crack will not initiate under the test conditions.

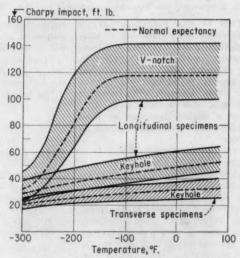
Many of the forming operations in pressure vessel manufacture are carried out at room temperature. This practice produces a certain amount of strain in the metal which usually has an adverse effect on properties measured by the Charpy test. Tests show that cold working



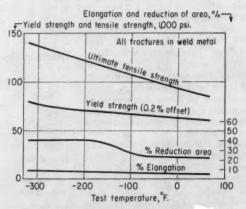
TEMPERATURE EFFECT-Fig. 1



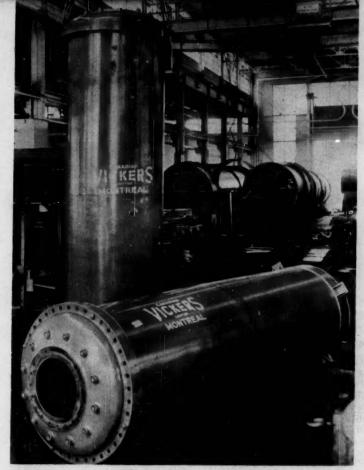
RECIPROCATING-BEAM fatigue tests-Fig. 3



CHARPY test values-Fig. 2



AS-WELDED tensile properties-Fig.



OXYGEN regenerators fabricated from 9% nickel steel-Fig. 5

As-Welded Charpy Impact Tests-Table III*

		V-Notch,		Keyhole Notch, Ft. Lb.	
Type of Weld	Notch Location	75 F	-320 F	75 F	-320 F
Metal-arc	Weld metal	68-80	60-71	33-39	28-34
Metal-arc	Heat-affected zone	119-127	68-82	41-50	29-37
Inert-gas	Weld metal	104-114	96-101	59-62	44-52
Inert-gas	Heat-affected zone	76-104	43-60	41-52	22-34

^{*}All welds made with Inco-Weld "A" electrode or wire.

As-Welded Charpy Impact Tests With Stress Relief at 1,050 F.— Table IV*

		V-Notch,	FtLb.		ole Notch,
Type of Weld	Notch Location	75 F.	−320 F.	75 F.	-320 F.
Metal-arc	Weld metal	68-72	56-64	38-41	29-33
Metal-arc	Heat-affected zone	79-86	73-74	41-48	34-40
Inert-gas	Weld metal	85-110	76-98	64-69	45-51
Inert-gas	Heat-affected zone	103-120	84-111	57-65	44-57

^{*}All welds made with inco-Weld "A" electrode or wire.

lowers the notch-impact strength of double-normalized and tempered 9% nickel steel at room temperature and at liquid nitrogen temperature. The lowest value is 17 ft.-lb. at -320F. for 10% cold work. This strain is more than that resulting from the usual cold forming procedures. Reheating to 1,050F., however, completely restores the loss in notch toughness due to cold working.

Section Size Has No Effect

Ordinarily the mechanical properties of specimens taken from the interior of a large steel forging or casting are not quite as good as those removed from outer portions of the same piece. An important reason is a difference in the rate of cooling of the metal volumes during heat treatment, which in turn affects microstructure and grain size. Tests show that 9% nickel steel is relatively insensitive to variations in section size. The tests compared the tensile and impact properties of standard plate with those of a sample cooled at a rate simulating the center of a 20-in. round and then reheated to 1.050F. as the final treatment. Little difference was noted.

Good Fatigue Properties

Fig. 3 summarizes the effect that low temperature has on the fatigue behavior of 9% nickel steel. These data show that, as the temperature drops to -320F., fatigue strength increases progressively.

A comparison of the resistance of several pressure vessel steels to plastic fatigue showed that 9% nickel would stand many more cycles to failure at a given strain. Pressure vessel materials are evaluated in terms of the allowable strain range producing failure in 100,000 cycles which represents normal pressure vessel life.

Welding 9% Nickel

Section IX of the ASME Boiler and Pressure Vessel Code covers welding of this steel. Paragraph UCS-56 of Section VIII requires welds to be stress relieved at 1,050F., and UCS-57 requires radiographic inspection of welds. Successful qualifying welds have been made in plate to 1-in. thick without preheat or thermal stress relief,



Carburized and hardened nickel steel valve-Fig. 6

but a preheat to 300F. is desirable under conditions of heavy restraint. Stress relieving is carried out at 1,050F, for a minimum time of 2

International Nickel's Inco-Weld "A" electrode gives the best results in the manual welding of 9% nickel steel-Inco-Weld "A" wire in inert gas welding. Welds with 25-20 chromium-nickel stainless steel (Type 310) are satisfactory but not as strong as the plate metal. The Code stress for vessels welded with 25-20 stainless is 18,500 psi, compared with 22,500 psi. for vessels welded with Inco-Weld "A" electrodes.

Properties of Weldments

Fig. 4 shows the relationship of tensile properties to temperature for specimens of 9% nickel steel welded with Inco-Weld "A" electrode. The values for elongation appear low because the base plate was stronger than the weld metal. with the result that most of the elongation occurred in the relatively small volume of weld metal. See Fig. 1 for actual plate elongation values.

Table III records the results of impact tests on 1-in, thick normalized and tempered plate joined with Inco-Weld "A" electrode and wire. These values show that 9% nickel steel readily meets ASTM A-300 requirements in the as-welded condition. Consequently this steel, when double-normalized and tempered, is useful for unpressurized low-temperature storage vessels which, because of their large size, cannot be easily stress relieved after welding. Table IV includes data on a similar series of weld

tests which were stress-relieved at 1,050F. after welding.

Applications

The first important low-temperature applications of 9% nickel steel were in oxygen and nitrogen regenerators in a 300-ton oxygen plant. International Nickel of Canada installed this plant in 1951 at Copper Cliff, Ont., to supply oxygen for the direct flash smelting of copper concentrate. Fig. 5 shows the oxygen regenerators, which are 4 ft. diameter by 14% ft. long and fa-in. thick. Working temperatures in these vessels range from about 80F. at the top to -280F. at the bottom—a substantial thermal gradient. Pressure is cyclical and varies from 65 psig. to near atmospheric every 120 sec.

Recently Cooper-Bessemer Corp. adopted 9% nickel steel for a variety of parts subjected to subzero temperatures in air and hydrogen expander engines. Cooper-Bessemer made this decision because of the satisfactory performance of carburized 9% nickel steel valves in air expander engines, see Fig. 6. This nickel steel readily met the requirements: 0.60 in, case depth with a minimum hardness of 55 Rockwell C and a minimum impact strength of 15 ft.-lb. Charpy V-notch in the core at -320F.

The 9% nickel steel alloy, chemically resistant to liquid oxygen and nitrogen, produces no corrosion products which could hamper the operation of valves and meters or cause unsafe conditions. The stress-relief treatment after welding produces a slight discoloration of the metal which, however, is harmless to contained fluids.

How Do Costs Compare?

Several fabricators of low-temperature gas-handling equipment have found that they can fabricate oxygen storage vessels from 9% nickel steel at a competitive level of cost. Refinements in welding and heat treating should improve the economic outlook. Further savings would result if X-ray inspection of welds and post-weld thermal treatment could be omitted.

Two other nickel steels are available for low-temperature service. They are 21% and 31% nickel steel and are already in common use. ASTM specifications are:

% Nickel Min. Test ASTM Temp. °F. Specification A-203, A & B... 21 -75A-203, D & E... 31 -150

One of the newer applications of these steels is in military installations in the far north. See Part II of this series (Chem. Eng., June 27, 1960) for a discussion of these steels.

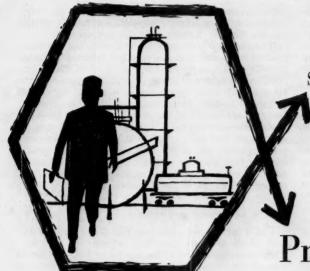
REFERENCES

1. Mounce, W. S., J. W. Crossett, T. N. Armstrong, Steels for the Containment of Liquefied Gas Cargoes, presented at the annual meeting of The Soc. of Naval Architects and Marine Engineers, New York, Nov. 1959.

2. Armstrong, T. N., J. H. Gross, R. E. Brien, Properties Affecting Suitability of % Nickel Steel for Low-Temperature Service, Welding J. Research Supplement, Feb. 1959.



R. J. JOHNSON graduated from Penn State University in 1942 with a degree in metallurgy. He then joined the Republic Steel Corp. where he worked on the metallurgy and development of alloy and stainless steels. In 1953 he joined the Pittsburgh technical field section of the International Nickel Co., and in 1958 transferred to the New York office where he works on product development. Johnson is a registered P.E. and a member of AIME, ASME, ASM and The British Iron and Steel Institute.



Systems Engineering, Part 7

Process Control

Following corrections of plant behavior, the project engineer asks the whys and wherefores.

THEODORE J. WILLIAMS, Monsanto Chemical Co., St. Louis, Mo.

Plant process changes suggested by the systems engineering group as a result of startup difficulties have been made. This has corrected all difficulties previously encountered. Now, the systems engineering group has received the following memorandum:

MEMO

TO: Systems Engineering Group FROM: Joe X. Smirk

We have made the changes and additions you recommended and the plant is now working fine. Would it be possible for you fellows to take some time and explain to me why you made some of the changes you did and how you decided that these were best?

Process control is necessary because chemical plants and petroleum refineries are subject to "upsets" in their operating conditions. These upsets may be either changes in rates or compositions of feeds, variations in process temperatures or in rates of energy supply or energy removal streams, required changes in product quality or demand, or combinations of these. Were it possible for the process to be insulated from such upsets, the process could be operated completely without controls.

Upsets must always occur in the independent or environmental variables of the process, i.e., they must be due in some way to external influences. A change in level of one or more of these independent variables is then reflected as compensatory changes in the levels of one or more of the dependent process variables. Control of the process can then be maintained only by imposing a counter change on process operation by changing still another independent variable. This counteracts effect of the first upset and restores the dependent variables to their former levels. The whole action requires use of instruments to detect presence of the upset and controls to compute and apply required corrections.

Detection and correction may be carried out in two ways. In one, the independent variable subject to upset may be sampled itself. Then, when upset occurs, steps may be taken to prevent its effects from reaching the process or to prepare the process ahead of time for their occurrence. Such control is known as anticipatory or feedforward control. Feedforward control can be quite satisfactory, but its disadvantage is that every independent variable that may affect the process must be sampled and its possible effects compensated.

In the second type of control, the dependent variable governing product rate or quality may be sampled. Then, when presence of an upset is detected by deviations of this variable from a desired value, changes can be made in operating conditions of the process which would tend to correct the detected deviation and thus compensate for the upset. Such control is known as compensatory or feedback control.

Feedback control is by far the more common; theoretically only one detecting instrument and one controller are necessary for the whole process, rather than one on each independent variable as for feedforward control. This concept of simplicity, however, suffers

^{*}Based on the 1959 Schoch Lecture at the University of Texas the series has appeared in *Chemical Engineering*, Feb. 8, 1960, pp. 121-6; Mar. 7, 1960, pp. 131-6; Apr. 4, 1960, pp. 139-44; May 2, 1960, pp. 121-6; May 30, 1960, pp. 97-102; June 27, 1960, pp. 113-118.



two important drawbacks. First, for complex processes, one correction method cannot possibly compensate for effects of variation in several different independent variables; second, a deviation must occur in value of the sampled dependent variable before corrective action can be taken, thus the variable cannot be maintained exactly at the desired specifications.

Best Control for Distillation Column

For a specified distillation column (fixed number of plates and fixed size) operated in the most effective manner (correct feed plate) and adiabatically (no heat losses or gains to atmosphere), there are only six independent operating variables. These, along with a listing of the corresponding dependent variables of the process are given in Table I.^{1, 2} If we could specify each of the six independent variables as constant, we could produce any separation for which the column was designed with no further concern, but since this is obviously not possible, control is needed.

With the list of independent and dependent variables, we can readily resolve the basic problem of

distillation control into three tasks.

 Determining which two of the four possible internal independent variables should apply.

 Determining most direct instrumentation method for sensing variations in independent variables specified as constants.

 Determining how the displaced variable can be restored to its chosen operating value through adjust-

ment of the control system.

For the internal variables to be truly independent, it's absolutely necessary that boil-up rate/feed rate ratio be specified as the ratio of respective stream rate to feed rate rather than simply the rate of vapor flow up the column. Depending on these choices, several different schemes for distillation column control may be suggested (Table II and Figs. 1, 2, 3 and 4).

For the instrumentation system chosen in each control scheme, certain internal independent variables should be selected. In Table II, these systems are arranged in order of increasing flexibility to illustrate development of the most complex and most capable

system.

The scheme of Fig. 1, requiring constant feed composition, is the simplest example possible. It may be entirely unrealistic in most plant situations because of this. This method has been called inferential or environmental control, and it can succeed only when it can prevent all upsets originating from external sources from reaching the column. Here flow controllers alone are sufficient to maintain steady operation, because only boil-up rate and distillate take-off rate need be kept constant.

A constant feed rate is required by the scheme of Fig. 2. It can be attained if sufficient tankage can be installed between the column and the preceding plant unit or if column is first in processing line. Desire for greater flexibility of operation, however, again prompts us to go on to the scheme of Fig. 3. Here resetting reboiler-steam-input-rate control by a cascade controller operating from feed input rate measurements permits us to maintain boil-up rate/feed rate ratio. It's then possible by maintaining necessary distillate take-off rate to keep feed split at required value for compensation of instantaneous feed composi-

tion changes. Feed rate and composition can vary independently as long as physical limitations of the column, such as flooding rate, are not exceeded.

Designation of boil-up rate/feed ratio and overhead product composition as the specified internal variables permits feed quality to vary along with feed composition. Slight variations of distillate take-off rate automatically compensate for flow variations caused by quality shifts. Thus, simple constant-temperature, feed-preheat control of Fig. 1 can be retained throughout all these examples. If this temperature can be set to give feed quality of 1.0 at lowest feed composition expected, and if the feed mechanism can handle a mixed feed, such an arrangement has been shown to help smooth out column composition fluctuations caused by change in feed composition.

Add a Composition Detector

Fig. 4 carries the scheme of Fig. 3 one step further and allows ambient operating pressure to vary too. This simplifies control of cooling water but now makes use of temperature alone as a composition detector impossible. In such a situation we must use some device that measures composition directly or measures another composition-sensitive but non-temperature-sensitive property, because temperature will vary drastically with pressure.

Study of possible variation of liquid boiling point (tray temperature) compared to resulting composition variation for various relative volatilities of binary mixtures has emphasized that it's absolutely necessary to maintain close pressure control if for control pur-

Distillation Variables—Table I

External Independent Variables

- 1. Feed rate
- 2. Feed composition
- 3. Feed temperature or feed quality
- 4. Ambient pressure of operation

Internal Independent Variables

- 5, 6. Two of the following four quantities:
 - (a) Overhead product composition (complete)
 - (b) Bottoms composition (complete)
 - (c) Boil-up rate-feed rate ratio
 - (d) Feed split or distillate-bottoms ratio

Dependent Variables

- All liquid compositions not already specified, bottoms, distillate, each plate.
- 2. Vapor compositions at each location.
- Temperatures at each location in the column.
 All unspecified flow rates both liquid and vapor, including distillate and bottoms takeoffs.

Semi-Independent Variables of Column Operation

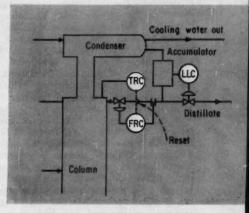
- 1. Feed tray location
- Column reflux temperature or cooling water temperature.
- 3. Steam pressure

(These can affect column control but are usually considered constant.)

Basic Column Control—Fig. 1 Cooling water in Cooling water out Condenser Accumulator Reset PRC Distillate Column Feed preheater Column Cooling water out Cooling water out

Bottoms

Control for Variable Feedstock—Fig. 2



poses temperature is the primary column variable detected by the sampler. Otherwise, another property must be used for satisfactory control. Often, however, nonavailability or lack of capability of instruments for this purpose dictates that column temperature be detected instead as a measure of this composition.

Reboiler

Thus, boil-up rate/feed rate ratio and overhead product composition are specified as the optimum internal variables for control. The case shown by Fig. 5 permits bottoms take-off rate to be determined by an auxiliary level controller in the reboiler. Constant heat-transfer area is maintained in the reboiler, and boil-up rate control can be tied directly to steam input rate. Any other scheme would result in level fluctuations with corresponding heat-transfer-area variations in the reboiler. Steam rate or pressure or both would have to vary in a complex manner to maintain boil-up rate at its established value.

Bottoms composition may be used as an independent variable, but since pot volumes are usually ten or more times greater than plate holdups, bottoms composition can vary only at correspondingly slower rate than plate compositions. A much greater sensitivity can be attained with overhead product composition as the independent variable even when the bottoms is the desired product.

A common error in distillation column control and indeed in all plant process control is that of excessive instrumentation or overcorrection of an upset. For

Relation of Variables—Table II

	Futana	l Variable		Choice of Fig.
	Externa	Aduable		internal variable No.
Feed Rate	Feed Composition	Feed Quality	Ambient Pressure	
Fixed	Fixed	Fixed	Fixed	Boil-up rate/feed 1 rate ratio
				Distillate rate/bot- toms-rate ratio
Fixed	Variable	Variable	Fixed	Boil-up rate/feed 2 rate ratio
				Overhead compo- sition
Variable	Variable	Variable	Fixed	Boil-up rate/feed 3 rate ratio
				Overhead compo- sition
Variable	Variable	Variable	Variable	Boil-up rate/feed 4
				Overhead compo- sition

example, it's common practice to use one temperature detector at the top of the column to correct overhead take-off rate and another further down the column to correct boil-up rate, both being designed to compensate for feed composition changes. Thus, two corrections of the column to correct boil-up rate, both being designed to compensate for feed composition changes.



tions are made for one upset, and if not very carefully adjusted they can overcorrect for each other to cause "internal upsets" and oscillatory operation.

Probably the most important of the semi-independent variables of column operation is feed-plate location. If feed composition does not vary greatly, one feed-plate location is sufficient. For some possible wide variations of feed composition, however, "pinches" and corresponding reduction in column separating capacity beyond capability of the control system to correct may occur. Thus, some sort of automatic feed plate changes would be desirable.

Feed-plate location is a function of feed quality as well as of feed composition. A chart can be developed which specifies optimum feed plate for any given column and feed mixture. Data from the chart can then be used to set a controller which, by means of quick-opening valves, could transfer feed from plate to plate as necessary when feed composition varied.

In all cases except Fig. 1, care has been taken to control the amount of reflux fed back to the column rather than to control directly the amount of distillate withdrawn. This is because in scheme of Fig. 1 any fluctuations in condenser vapor rate would be propagated by an accumulator level controller to the reflux stream. We must avoid this whenever possible, because it has been shown that such fluctuations can be self-propagating and can lead to sustained control oscillations if cold reflux is used on the column.

Table III and Fig. 5 summarize the above points to give the over-all optimum control system for a distillation column. Let's now compare these recommendations with the final control scheme recommended by the systems engineering group for the distillation column of our example plant.

Recommended Control Scheme—Table III

Main Control Functions

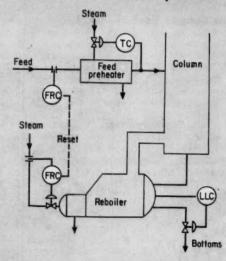
Designated Independent Internal Variable	Method of Determining and Regulating Required Variation		
Overhead product composition	Sampled by dependent variable near top of column and maintained as constant as possible by resetting of reflux rate controller.		
Boil-up rate/feed rate ratio	Variations of feed rate detected by a flow controller and used to reset the steam input rate controller which has been previously set at some in- termediate rate for the task at hand		

Required Subsidiary Controls

Subsidiary Variable	Method of Control
Feed temperature	Feed preheater on feed line or a source of constant temperature feed
Bottoms take-off rate	Level control on reboiler
Pressure (where necessary for temperature elements)	Variation of condenser cooling water rate or separate pressure control

Distillate take-off rate Level control on accumulator

For Variable Feed Rate & Composition-Fig. 3



Our plant column is fed an essentially constanttemperature feed because of the control over decanter fluid temperature exercised by the reaction-cooler heat exchanger. Even though a quite subcooled feed is fed to the column, its already essentially constant temperature eliminates need for a feed preheater. The column can readily be designed, as here, to handle the extra downcomer load involved.

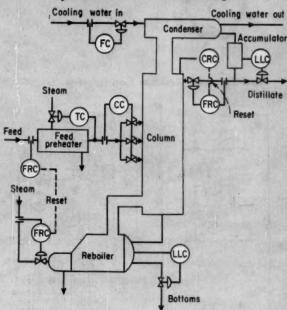
Column is subject to the possibility of some considerable variation in feed rates. Addition of feedforward control of boilup rate as a direct function of feed rate suggested composition control of overhead product. This is because of the very high purity of the plant product withdrawn here and the resulting insensitivity of temperature as a purity monitoring method.

Because the column is essentially a stripping column with a very large number of plates for the relative volatility of the material to be separated, it was decided that it would not be necessary to provide the possibility of automatic feed plate change to assure top column separation efficiency. This feature was thus not included in the recommendations to Joe Smirk.

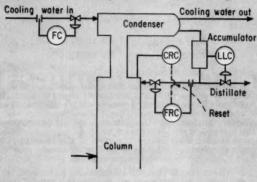
Basis of Reactor Control Proposal

Control of the stirred-tank reactor, the other major change recommended in the plant control system, also deserves comment. Either of two methods could have been applied to develop the improved reactor control system required to handle upsets in flow of reactant A to the reactor found by the plant test investigation. One, which consisted of smoothing out possible variations in reactant availability by additional surge volume in the line was the method described in Part 6 of this series. The second requires development of a

Optimum Column Control-Fig. 5



Control With Composition Detector-Fig. 4



feedforward control system to detect upset and make the required changes in reactor control settings needed to anticipate effects of the upset upon reactor response.

The first method requires that additional capital be tied up in cost of the tank and in average amount of inventory which it would contain. On the other hand, the second method requires a more complex and costly control system and may impose some penalties in production capacities depending upon existing plant operating conditions.

Changes in the rate of availability of A, with the corresponding changes in flow rate of reactant B produced by a ratio control system, have their chief effect on reactor response in changing residence time in the reactor. The chief method of correcting for residence-time effects must be by changes in operating temperature level of the reactor. Shortened residence time caused by increased flows requires a higher temperature with the resulting increased reaction rates to achieve required increase in production. Conversely, decrease in flow of reactants necessitates a decrease in reactor temperature.

Amount of increase or of decrease in temperature would not be directly proportional to the observed change in reactant flow rates for three reasons:

1. Reaction rates are an exponential function of temperature; a greater decrease than increase in temperature would be required to compensate for a given percentage decrease in flow rates compared to the corresponding increase.

2. Since tar formation is enhanced by temperature increases, such temperature increases required to compensate for rate increases must be kept as low as possible at some expense in production rate.

3. The large amount of recycle tends to greatly reduce immediate effect of reactant feed rate changes. This, however, is temporary, and continued operation

at the new rate eventually requires full compensation.

Fig. 6 presents a diagram of the feedforward control system necessary to carry out the above procedures. Since the proposed nonlinear temperature reset controller is a feedforward device, it is unable to distinguish signals due to real changes in flow rate from those caused by flow meter error or malfunction. Therefore, the composition controller (CRC) has been installed in the product line. This device will monitor the reactor output stream and signal deviations from the desired product composition. It's not used for primary control of the reactor because rates of change of composition will be slow and operation of the analyzer is also slow. Result would be a response which probably could not correct for known upset frequency in this reactor.

Assuming that penalties of higher tar formation rates are not especially serious, choice between this control system and the one actually recommended by the systems group balances relative capital costs of the storage tank and increased inventory versus costs of the special controller and the product analyzer. For this case, where reactant costs are so low, the choice is quite clear. In many other cases, though, it would not be so clear and might well favor the second method. Each would be judged on its merits.

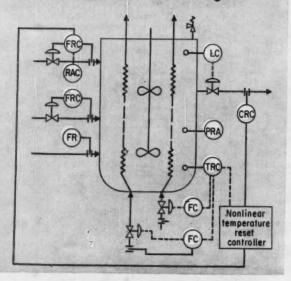
Another consideration here is that possibility of instrument failure always leads one to choose the simpler system, all other things being equal. Therefore, since both systems were designed for the same task, the simpler one containing the surge tank would be preferred.

Control Analysis of the Example Process

As indicated in Part 1 of this series, large-scale computers, particularly analog computers, can be ex-



Feed Forward Reactor Control-Fig. 6



Additional Reactor Equations—Table IV

$$\frac{dT_{W}}{dt} = \frac{1}{V_{W}} \left[h_{W} A_{W} (T_{R} - T_{W}) - F_{W1} (T_{W} - T_{Win}) \right]$$
 (1)

$$\frac{dT_{Z}}{dt} = \frac{1}{V_{Z}} \left[-h_{Z}A_{Z}(T_{Z} - T_{R}) + F_{Z}H \right]$$
 (2)

$$F_{W1} = K_1(T_R - 180), \quad T_R \ge 180 \text{ F.}$$
 (3)

$$F_Z = K_2(180 - T_R), \quad T_R < 180 \text{ F},$$
 (4)

Additional Assumptions Relating to Control

1. For a first approximation, the speed of response of all level control, pressure control, and flow control loops will be considered sufficiently fast so that their dynamics will not significantly affect over-all process dynamics. Thus the reaction-cooler heat exchanger, decanter, and column controls will not be considered in this first go-around. They must, of course, be considered in the more detailed study later. The effect of this assumption is to make the algebraic relations on flow ratios already specified in Part 5 sufficient for this first approximation.

All sampling devices will be considered to be ideal, that is, possible errors in their determination of the true value of the variable they are sampling will not be considered.

New Symbols Used

Heat of condensation of steam.
Proportional gain factor for controller.
As subscript, refers to reactor coolant system.
As subscript, refers to reactor coolant.
As subscript, refers to reactor heating system or to steam

tremely helpful in control system design and can, in fact, remove most of the guess work from studies of control system specification, improvement or adjustment. Such procedure would be particularly applicable in developing and proving out the feedforward reactor control system just postulated. To carry out such a computer study, or simulation, a complete mathematical model of the whole plant or of the plant unit in question is needed. This usually takes the form of a large set of simultaneous ordinary differential equations as shown in Part 4.

Although the simplifying assumptions don't affect steady-static economic optimization, they can be extremely critical when we consider automatic control aspects of the process. Therefore, computer simulation carried out to design an automatic process control system must usually be divided into two parts. First, an over-all simulation should be made using the previously derived equations plus other equations specifying the major proposed control functions to determine the pattern of propagation of any upsets through the plant and their over-all effect upon production rates and plant stability.

Second, an exact analysis must then be made of each major plant unit considered separately, while at the same time eliminating as many as possible of the simplifying assumptions necessary for the over-all analysis. Each simulation would then be tested by applying to it the type of upset function which was predicted by the preliminary analysis. The simulated control system can then be adjusted or revised until satisfactory control is obtained for that specific unit.

Often the results of this exact analysis will dictate a modification of the proposed major control functions in the approximate system set up for the preliminary study. In this event, the preliminary study must be repeated with the revised control elements included to obtain the new upset propagation patterns, which can then be re-evaluated in the exact simulation. By repeating this two-step analysis as often as necessary, the optimum control system can be obtained.

Table IV presents additional equations required to carry out the first step, or preliminary over-all control analysis, for the original control arrangement presented along with the description of the various plant units in Part 5. Additional assumptions involved in our analysis from the automatic control viewpoint are also included in Table IV.

With preliminary assumption that flow control, level control, and pressure control loops are fast enough in relation to major process time constants to have negligible effect on plant dynamics, reactor control dynamics are the only significant factors remaining. Only reactor control equations, therefore, need be presented in Table IV.

Analysis such as described here has been the subject of several articles. The distillation control system described herein was developed in this way.1.4 Other system studies worthy of note include extraction columns. " distillation column and chemical reactors."

REFERENCES

- Williams, T. J., Ind. Eng. Chem., 50, 1214-1222 (1958). Bauer, R. L., and C. P. Orr, Chem. Eng. Progr., 51, 312-318

- 2. Bauer, R. L., and C. P. Orr, Chem. Eng. Progr., \$1, 312-318 (1954).
 3. Keguchi, S. T., and R. L. Ridgeway, Pet. Refiner, Dec. 1956, pp. 179-184.
 4. Williams, T. J., R. T. Harnett, and A. Rose, Ind. Eng. Chem., 48, 1008-1019 (1956).
 5. Woods, F. A., Ind. Eng. Chem., 50, 1627-1630 (1958).
 6. Rosenbock, H. H., British Chem. Eng., 3, 364-367, 432-435, 491-494 (1958).
 7. Batke, T. L., R. G. Franks, and E. W. James, ISA Journal, 4, 14-18 (1957).
 8. Lewis, L. G., Instruments and Automation, 31, 644-647 (1958).

Designing Reactors for Operation

In a continuous reactor the possible errors in feed composition of the different components, and the permissible error in the resultant effluent stream, markedly affect reactor size and retention.

MAX S. BASS, Project Engineer, Heyden Newport Chemical Corp., Fords, N. J.

Being faced with the need to desigh a new continuous reactor on the basis of experience with a batch process for the same reaction, we cast about to see what problems would be met in determining the proper size for the new reactor. It is obvious, of course, that there are such problems: Proper agitation, sufficient freeboard, a suitable ratio of reactor volume to surface area, proper retention time, and the like.

In addition, we found three types of question that had very profound effects on the basic design:

 What error in effluent stream concentration could be permitted without adverse effect on subsequent processing steps?

• How much time would be needed for sampling, testing and subsequent readjustment of the feed streams to the reactor; and how often could such time-consuming procedures be tolerated?

 How accurately could the feed streams to the reactor be controlled?

Following is the derivation of an

equation which incorporates these variables as a function of retention time and the errors in feed and discharge rates:

Let the intended or ideal composition of the incoming feed in key component G be g, and let the error in this composition be E_{in} . Then, incoming feed composition will be $g(1 + E_{in})$ or, if $W = (1 + E_{in})$, then incoming feed composition is gW. If the incoming feed rate is a, then the input to the reactor for a short interval is $agWd\theta$. If y is the instantaneous composition of the reactor content in key component G and V is re-

actor volume, then the total reactor content of G will be Vy, and any change in reactor content will be Vdy, which equals input minus output, or

$$V dy = agW d\theta - ay d\theta$$

$$= a(gW - y) d\theta$$
(1)

Let

$$-x = -y + gW$$

Then

$$dx = dy$$

and

$$V dx = -ax d\theta$$

or

$$dx/x = -(a/V) d\theta (2)$$

Integrating

$$\int dx/x = -(a/V) \int d\theta \qquad (3)$$

$$\ln x \bigg]_{y_a}^y = -(a/V)\theta \tag{4}$$

or

$$\ln \frac{y - gW}{y_0 - gW} = -(a/V)\theta \tag{5}$$

Since V = ka and $y_* = g$,

$$\frac{y-gW}{g-gW}=e^{-(\theta/h)}$$

Now, putting the concentrations into the error form, $E_{\rm out}=(y-g)/g$ and $y=g+gE_{\rm est}$. At the start of the process $y_*=g$ so, substituting in (6) and letting W have its value of $g+E_{\rm in}$,

$$\frac{g+gE_{out}-g-gE_{in}}{g-g-gE_{in}}=e^{-(\theta/k)} \quad (7)$$

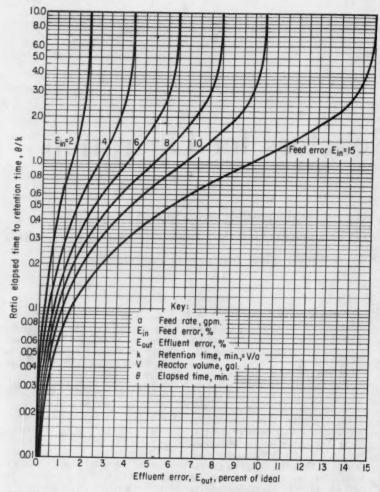
Max S. Bass, a former assistant plant engineer with Allied Chemical in Delaware, is now a project engineer with Heyden Newport. He will be remembered as the author of the article on volumetric tanks for batch measurement which appeared in our Oct. 20, 1958, issue.

Nomenclature_

- a Flow rate of entering stream,
- e Base of natural logarithms, 2.718.
 % error in feed rate of key component G, expressed as % deviation from ideal feed rate.
- Esul % error in effluent stream, expressed as % deviation from ideal.
- g % concentration of key component G in feed stream under ideal conditions.
- k Retention time, min. k = V/a.
- V Reactor volume, gal.
- w Dimensionless group, $1 + E_{in}$.

 y % concentration of key compo-
- nent G in vessel at time θ .

 y. % concentration of key component G in vessel under ideal operating condition, $y_* = g$.
 - Elapsed time, min.



SOLUTION to Eq. (8) finds retention time in terms of error relations.

Simplifying.

$$\frac{E_{in} - E_{out}}{E_{in}} = e^{-(\theta/k)} \quad (8)$$

Equation (8) is plotted in the accompanying chart. With it, we can: (1) Check on the anticipated hourly requirements for operating personnel; (2) investigate the size of vessel, in terms of reactor feed rates, needed for good operating practice; and (3) determine the allowable concentration deviation in the reactor vessel and the errors permissible in the controlled feed streams to the reactor.

This means that, in any new installation, if we analyze the overall operating problems of manpower requirement, the adequacy of the feed and ratio control systems and the necessary sensitivity of the measurement and response of the control system, then we can determine the proper retention time for the installation.

This procedure is best illustrated by the two following examples:

Example 1—Problem is to size a continuous reactor which is to be fed 2.5 gpm. of total reactants. We expect that the error in the controlled feed stream will not exceed 10% and we decide that the percentage error in the tank and its effluent should not exceed 5%. The operator is to make periodic checks to determine whether there is a deviation from the required operating point. If there is, he will make

the necessary flow changes. What should the reactor sizes be for intervals of (a) 2 hr.; (b) 4 hr.; and (c) 8 hr. between operator checks.

Solution 1—From the conditions, $E_{1a}=10\%$ and $E_{out}=5\%$. From the chart, $\theta/k=0.7$. Therefore, for Part (a), $\theta=2$ hr., k=120/0.7=171.5 min. and $V=ak=2.5\times171.5=429$ gal. For Part (b), $\theta=4$ hr., k=240/0.7=343 min. and $V=ak=2.5\times343=858$ gal. For Part (c), $\theta=8$ hr., k=480/0.7=686 min. and V=ak=1.716 gal.

Here the maximum allowable error in the effluent stream was set at 5% because, at that particular deviation in concentration, there would be a significant change in pH which would be detrimental to the over-all product yield. Retesting and flow adjustment by the operator would be a time-consuming burden which could be tolerated only once or twice per shift. The analysis shows that, based on two checks per shift, the required working volume would be 858 gal. An additional 292 gal. capacity was added for freeboard, normal level variations and contingencies, so the final design volume became 1,150 gal.

Example 2—Conditions are the same as Example 1 except the maximum permissible error in the effluent is 3%. From the chart, $\theta/k = 0.36$. The results for the three cases will be 0.7/0.36 = 1.45 times as large. Hence for $\theta = 120$ min., V = 834 gal.; for $\theta = 240$ min., V = 1,668 gal.; for $\theta = 480$ min., V = 3,336 gal.

Example 3—In an existing reactor, the ratio controller for the feed streams can permit an error up to 10% in one of the components. However, we encountered subsequent pumping difficulties if the error within the tank approached 4%. The problem then was to find how often a manual check and adjustment of the feed streams was needed to bring the system into balance. The tank size V was 1,000 gal. and the feed rate a was 0.7 gpm.

Solution 3—k=V/a=1,000/0.7=1,430 min. From the chart, with $E_{\rm in}=10\%$ and $E_{\rm sat}=4\%$, $\theta/k=0.51$. Hence, $\theta=0.51$ $k=0.51\times1,430=729$ min. This indicates that the maximum time between tests and adjustments should be 12 hr., rather than the 24-hr. period we had been using.

PRESTIGE

Q	Do you think an engine ing in engineering, or	eer woul going i	d be bet nto man	ter off stay- agement?*
A		Engineers Unionized	Not .	Managers Of These Engineers
	Say an engineer would be better off by going into management. In financial terms: In terms of prestige:		90% 90%	65% 72%

That Other Grass Is Always Greener

Given a choice, would you be better off five years from now by staying in engineering, or by going into management? Most engineers say, "in management."

In spite of all the time, money and effort that has been poured into promoting the idea that engineering is a satisfying profession, most engineers today believe that they'd be better off in management.

This conclusion will be part of the soon-to-be-released survey on "Engineering Professionalism in Industry" conducted by Opinion Research Corp. (ORC), Princeton, N. J., during April and May of this year for the Professional Engineers Conference Board for Industry. The Conference Board is a wholly owned subsidiary of the National Society of Professional Engineers (NSPE).

Probable final results of the survey were previewed for members of NSPE at their meeting in Boston last month. So far only eight of the ten companies in the survey sample have completed their interview schedules. However, ORC predicts that the final percentages will not vary from those calculated for the preview presentation.

► Survey Design—Design of the survey calls for interviewing engineers and engineering managers in ten billion-dollar corporations. Five of the employers bargain collectively with engineering unions and five do not. Industries represented are: chemical, petroleum, rubber, aircraft, electronics and electrical machinery.

By careful selection of the survey sample across the broad range of industry, and by including both unionized and non-unionized engineers, ORC expects to come up with a reasonably reliable answer to this broad question, "What do engineers and engineering managers mean by professionalism, and how do they think it can be best advanced?"

Usually the identification of participants is a closely guarded secret. But during the question-

^{*}Exact wording: "Suppose an engineer at your company were considering whether to stay strictly in engineering or to move into management. Assuming proper qualifications for either field, do you think in five years he would be better off financially by staying in engineering or by going into management? In terms of pressing, where would he be better off?"

and-answer session in Boston an engineering manager from the Phillips Petroleum Co. announced that he had been interviewed and that his company was one of the five non-union partici-

What are the important elements that help

Fill in your own answers in the boxes below. Compare

with survey answers by folding and aligning p. 130.

build engineering professionalism?

pants. Also, the presence of two engineering union presidents in the audience and the selection of panel members who discussed the results established clues that may lead to the identification of Boeing Airplane Co., Dow Chemical Co., General Electric Co. and Radio Corp. of America as other participants.

Survey conclusions are based on the preliminary findings that have come from interviews with 209 engineers and 40 engineering managers. Assuming that the sample has been properly picked and that it is truly representative of the entire population, its small size does not negate the reliability of the results.

There is one important thing to remember in reading the results, however. Because of the small sample size, percentage scores that are less than about eight or nine points apart do not reflect a statistically significant difference in opinion. Until the percentage scores begin to spread by ten or twenty points, there is no real difference in the answers. Fifect of Unions—In a number of the survey charts you will see a comparison between the thinking of engineers and that of managers.

Another part of the research design calls for comparing attitudes of engineers who are not unionized with attitudes of engineers who belong to engineering unions, or who are bargained for by engineering unions.

► How Important?—First question asked was, "How important is engineering professionalism?" Most respondents said, "Very important."

This question has no practical use, since it is very similar to asking individuals if they are against sin. Most people will declare that they are definitely against sin. And most engineers and engineering managers will aver that engineering professionalism is very important.

More important are the answers to the question, "What does engineering professionalism mean to you?" We've tabulated the responses under the heading of "identification" on the facing page.

Note that engineers most often

DEVELOPMENT

We	re's a list of things some engineers to ould you read through the list first. To a think the item is important in buildi	hen tell me	in each case	whether	
Ite	m	Very Important	Fairly Important	No Opinion	
1.	Seek out opportunities for further advancement or degrees in special or advanced areas of engineering knowledge				
2.	Belong to one or more professional or technical engineering societies				
3.					
4.	Become registered, or take steps to register as a Professional Engineer.				
5.	Allend meetings of professional and lechnical societies as often as desirable				
6.					
7.	Learn as much as possible about the business objectives concerned with products or projects on which the engi- neer is working.			_	
8.					
9.					
10.	Discuss with manager any problems he sees in policies or actions that tend to undermine the professional status of engineers in the company				
11.		П			
12.	Use the letters "P. E." or "Registered Professional Engineer" after one's name, when registered				
13.	Identify himself with the goals of the company as a whole, not just the project or product he is directly con- cerned with.				
14.	Keep informed about other functions in the company, e. g., sales, manu- facturing, etc				
15.	Take part in community activities related to engineering, e.g., part-time teaching or socational counseling				
16.	Take part in community activities not related to engineering, e.g., service clubs, fund raising, etc				
40.	00 2 4 4 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2				

cite technical competence and skill and prestige for the profession as the meaning of professionalism. On the other hand, engineering managers think of things like a high standard of ethics and an attitude of individual responsibility, in addition to technical competence and skill. ▶ Building Professionals — Digging deeper into the subject of professional development of engineers and what they themselves can do to help build a spirit of engineering professionalism, the probers set up a list of 17 items.

Respondents were asked to read through the list of items and then indicate whether they thought the items were very important, fairly important, not too important, or whether they had any opinion at all on the subject.

We thought you'd like to try

this yourself.

On the page at the left you will find the 17 items listed with boxes provided for you to check off your own answers. To compare your answers with the survey answers, just fold over the page you are now reading and line up your answers with the survey item numbers.

Results are reported as the percentage of engineers who thought that the item was very

important.

▶ Company Orientation — Perhaps the most important finding in analyzing the response pattern is that engineers are quite receptive to the idea that it is one of their responsibilities to become more company-oriented if they wish to build professionalism.

True, they put high on their list those things strictly related to the techniques of engineering. But note all the things they list as important which bear on their closer integration with the com-

pany.

After footing the bill for the entire survey NSPE is going to be most unhappy with the relative importance of using the letters "P. E." after your name. It was the least important item in the minds of engineers and of managers.

► Individual Responsibility — The desire to become more company-oriented is an interesting reply in the survey, and in some ways very surprising.

REWARDS

Q	What are the principal rewards of an engineer		
A			ers Who Are Not Unionized
	Interesting work, creative, challenging, varied	53%	50%
	Sense of accomplishment	33%	36%
	Doing what I like and want to do	12%	18%
	Socially useful	9%	12%
	Financial rewards	42%	32%

Engineers Council for Professional Development (ECPD) has been promoting a special program of professional development for young engineers to be followed during their first five years out of college. The entire basis for the program is the concept that professional develop-

ment is an individual responsi-

Many of the things that ECPD suggests as important items in the development of individual professionalism scored relatively low in the survey list.

► Which Profession? — Several years ago at the opening of the

IDENTIFICATION

	Water St. Sec. V. Dance.	Engineers	Who Are	On The State
A			Not Unionized	Engineering Managers
	Technical competence and skill	14%	30%	48%
	Prestige for the pro- fession	14%	20%	13%
	Becoming more like lawyers and doctors	11%	13%	8%
	High standard of ethics	4%	12%	23%
	Attitude of individual responsibility	8%	9%	25%

Academy of Advanced Management in Saranac Lake, N. Y., your editor discussed with Lawrence Appley, president of the American Management Assn., and with Don G. Mitchell, president of Sylvania Corp. the relative ranking of the professions of management and engineering.

"Let's assume," I said, "that it is the responsibility of each American to develop himself to the highest level that he is capable of, would someone who possesses the qualifications for both be better off entering the profession of engineering or the profession of management?"

Very Important

8

1-64

2-34

3-49

4-39

5-33

6-56

7-62

8-32

9-35

10-54

11-20

12-13

13-48

14-39

15-26

16-21

17-77

Item Number

Appley and Mitchell both suggested that the question was a bit premature since, although management was definitely becoming a profession unto itself, it had not quite arrived at the same level with engineering, law, medicine and theology.

The results of the survey we are now discussing indicate that in the minds of engineers, the profession of management has arrived. Most engineers think they'd be better off in management.

But—and a big but it is—the engineers who have already reached the green pastures of management are not unanimous in agreeing that management is as rewarding as engineers seem to think. Note that in the tabulation on p. 127, 35% of engineering managers do not think that they are better off in financial terms, and 28% do not think that they are better off in terms of prestige.

Although the grass on the other side of the fence always looks greener, it may not seem that way to those who actually graze there.

What Are the Rewards?— This leads to the question of what are the actual rewards of a career in the profession of engineering. The chart on the top of p. 129 tabulates the answers to the following question:

"If a friend asked you about engineering as a career, what would you say its principal rewards and satisfactions are?"

Interesting, creative, challenging and varied work and a sense of accomplishment scored relatively high. Socially useful, scored low.

There is a difference of opinion about the meaning of the answer "financial rewards." ORC will publish these conclusions:

"The first four categories, which we feel are related, indicate that the engineer is largely motivated by satisfactions connected with the work itself. He is interested in his work as a fascinating end in itself—solving technical problems, doing what he likes to do—and he has associated satisfactions resulting from a job well done. Unlike people in some other fields, the engineer does not put at the head of his list such rewards as working with people or straight financial success.

"However we must be careful not to discount financial rewards too much. They are mentioned by sizable minorities of engineers in this table. If we might speculate in the mathematician's terms for a moment, we might say that financial rewards are a necessary, but not a sufficient condition for an engineer's satisfaction."

We respectfully suggest that ORC ask its industrial psychologists to re-read the question that was asked and then rewrite their conclusions.

The question actually asks the engineer to tell a friend what he is now getting out of engineering. It does not ask him to indicate what he would like to get out of engineering. Thus, the first actual reward that jumps into his mind is not financial. Instead, he sort of rationalizes and explains that he is getting his main kicks out of interesting work and a sense of accomplishment.

But this doesn't mean that, if he had any control over the situation, he would not want the financial reward to be his foremost reward. The key to this analysis is given in the survey answers to the question, "Has engineering met the expectations you had of it? Or, to put it in another way, if someone asked you about the possible drawbacks to an engineering career, what would you tell him?"

Number one on the hit parade of drawbacks to engineering at non-unionized companies is "insufficient financial rewards." On the other hand, unionized engineers did not give financial rewards the top priority. Instead they listed mal-utilization and insufficient recognition of professional status.

Non-unionized engineers want more financial rewards and unionized engineers are more concerned with recognition of professional status and proper utilization of their professional talents. There is something for the psychologists at ORC and directors of NSPE to think about. The obvious answer may be that unionized engineers are better paid than their non-union counterparts.

▶ Who's Responsible—The survey asked engineers and their managers whom they thought should be responsible for promoting engineering professionalism among industry-employed engineers.

It is rather strange to this observer that the majority of engineers favored putting the responsibility squarely on the shoulders of management, rather than on the engineers themselves or even assigning the responsibility to both engineers and management.

This is a far cry from the concept that professional development is an individual responsibility.

As the survey goes on to point out, companies are indeed doing many things to build the professionalism of their engineering employees.

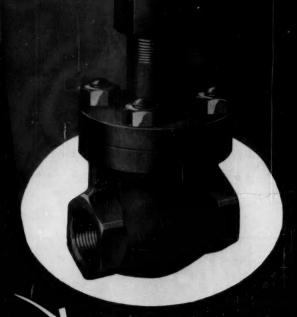
However, one of the results of the survey ought to be some healthy re-examination of the programs of the professional engineering organizations concerned with professionalism and professional development.

Why do so many engineers think its better to leave the engineering profession?

ANSWERS Survey question p. 130.

Fold this page back onto checklist of p. 128 to compare with your answers.

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CE COST FILE

No. 36 Plate-and-Frame Filters

J. L. Hutton, Jr., T. Shriver & Co., Harrison, N. J.

capital-cost estimating data in the much use, even when factored up to date with indexes such as the Marshall & Stevens. In a recent literature are too old to be of Many order-of-magnitude

-Purchase cost, \$, May 1960

15,000

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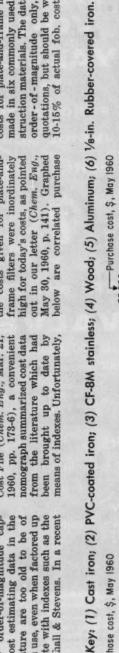
8,000 6,000 5,000 4,000 3,000

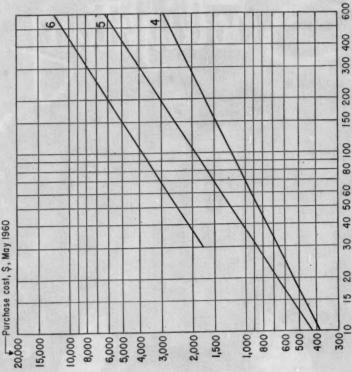
Cost File (Chem. Eng., Mar. 21, 1960, pp. 173-6), a convenient nomograph summarized cost data the literature which had brought up to date by means of indexes. Unfortunately, been from

the costs given for plate-and-

made in six commonly used construction materials. The data are order-of-magnitude only, not quotations, but should be within 10-15% of actual fob. costs. costs for plate-and-frame filters

frame filters were inordinately out in our letter (Chem. Eng., May 30, 1960, p. 141). Graphed below are correlated purchase high for today's costs, as pointed





Filter orea, sq.ft.

300 400

150 200

40 50 60

30

20 2

300 10

Filter area, sq.ft.

009 500 400

0001

800

2,000 1,500

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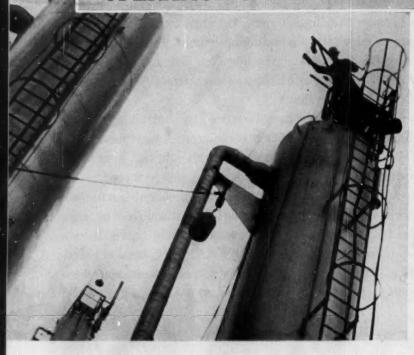
Big jet aircraft make money only when they are in the air. Every minute they are earthbound is costly. You just can't take chances on failure of aircraft engines from fuel contamination, or on failure of refueling equipment. That's why those parts of Brodie BiRotor refueling meters and control valves that come in contact with the fuel are chemically plated with KANIGEN nickel alloy.

Brodie BiRotor meters have been used for controlling aircraft refueling for many years, and their internal parts have been KANIGEN-coated ever since this highly accurate method of plating difficult or complicated surfaces was perfected.

Do you have a corrosion or contamination problem? Is it a small part like the Brodie meter housing? Or is it a surface as large as the inside of a 20,000 gallon tank car? Whatever it is, there's a way to solve your problems with KANIGEN chemical nickel plating. Write or phone the nearest General American office.



OPERATION & MAINTENANCE EDITED BY P. J. BRENNAN



Retraying Bubble Cap Columns

Many hands make light work on big job. Doubling up uses as many crew hours, but cuts time in half.

James Tipton, Texas Gas Corp., Houston, Tex.

Recently we retrayed two 72in. bubble cap absorbers at our Winnie, Tex., plant. Lessons learned on the first tower cut the time required for the job on the second tower by half. Though the towers were in ab-

sorption service, our technique would apply equally well to any tray type fractionation unit where retraying is to be done by men working inside the vessel.

New Yeb Did It—Process calculations indicated that we could increase the capacity, absorption oil rate and recovery efficiency of the absorbers by replacing or modifying the existing bubble

cap trays. Since the cost of modifying the old trays was comparable to the cost of installing new valve type trays, we decided to install new ones. Down time for retraying was a major factor in the overall economics of the job since every hour the unit was off stream cost money. ▶ Plan Before Shutdown—Engineering, construction and maintenance groups discussed and agreed upon preliminary plans for the quickest and safest way to do the job. After they agreed on a tentative plan, the construction superintendent at the Winnie plant prepared a detailed

work schedule which was then reviewed with the men who were actually going to do the work.

Each specific function assigned to each craft, both before and during the shutdown was listed in the detail work schedule. This schedule included sketches of the absorber showing the location of blinds to isolate the vessel and the location of steam and water connections for purging the tower.

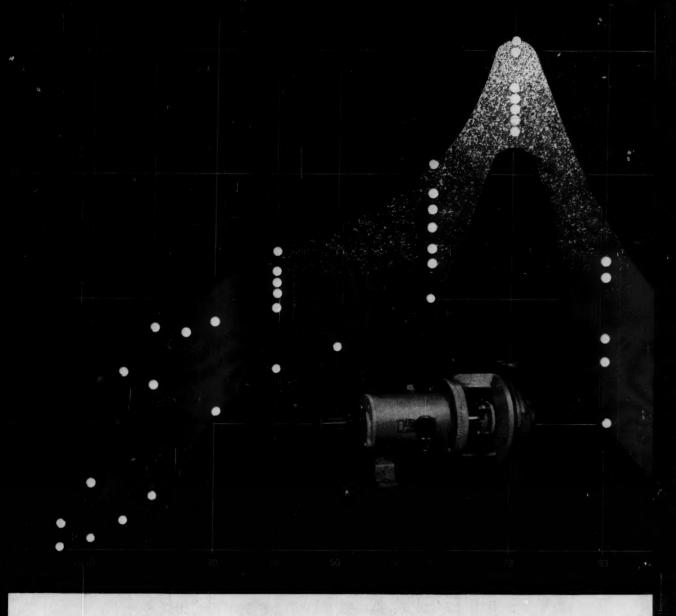
There was also a graphic schedule in bar graph form so that actual and predicted progress could be quickly noted. We also prepared a simplified composite graphic schedule and posted it at the job site so that all personnel throughout the plant could see the progress.

Prior to the actual shutdown we moved all materials to the job site and separated them into numbered buckets. Templates were made to indicate the place to cut the old trays and to guide the installation of the new trays. An air-driven hoist was rigged to raise new parts to top of the tower and to lower old tray sections. One tray was completely assembled outside the tower so that the problem could be better understood by the men. Electricians prepared drop lights for heavy duty service and a sound powered phone system from the tower top to the ground level. communication system proved to be a must for the hoist operator and for the men in and on the tower.

One crew at a time working inside the tower retrayed the first absorber. On the second job, however, the tower was divided into two working areas by temporarily leaving in one of the old trays as a divider. Thus two crews could work in the tower simultaneously with the divider protecting the bottom crew from falling debris.

The drawing on p. 136 illustrates the differing approaches to the two jobs. It also illustrates some other improvements on the second tower that resulted from our experience on the first.

Personnel Assignment—Once



Specifically built for pumping sulfuric

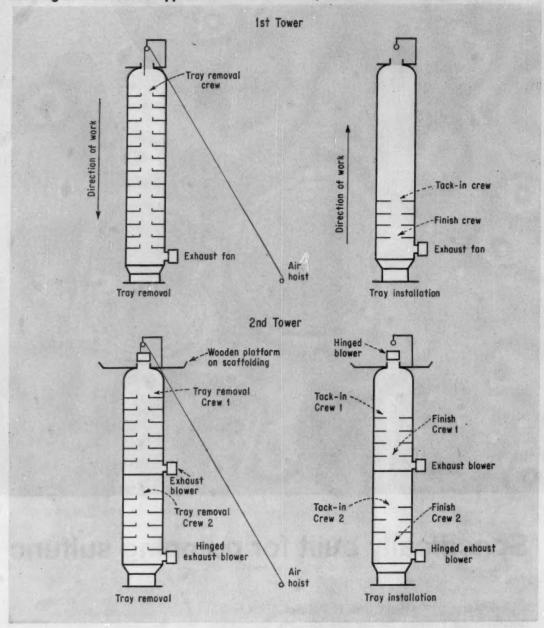
Durcopumps with wet-end parts of Durimet-20 are built specifically for pumping sulfuric acid solutions. Corrosion is negligible at 80° C. for concentrations up to 65% and above 93%. For temperatures of 60° C. and below, corrosion is negligible in all concentrations.

This is just one of the many corrosives for which special alloy Durcopumps have been specifically engineered. Pumps are available with heads to 345 ft. and capacities to 3500 gpm. Ask your local Durco Engineer for advice on your specific application—or write for Bulletin P-4-100.



Serves the Process Industries

Drawing Shows Different Approaches to Two Jobs, Improvements on Second Tower



the actual retraying began, the crews worked two 12-hr. shifts rather than three 8-hr. shifts. Each shift for the first unit was composed of a leaderman and six pipefitter-welders as follows:

First tower—removing old trays:

Leaderman.

Two men inside tower, cutting.

Two men at tower top.

Man handling materials.

Man operating hoist and miscellaneous outside.

These duties rotated so that the

inside crew changed every two hours.

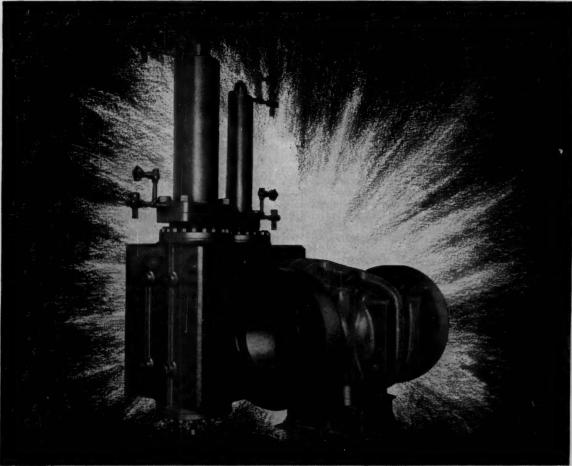
First tower—installing new trays:

Leaderman.

Crew 1—two men tacking in support rings and positioning side panels.

ALLIS-CHALMERS





Rotovalve unit for 2700-psi, 1050 F service.

A must for nuclear reactor service . . . valves that

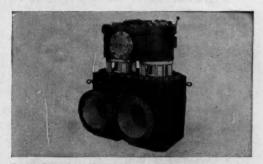
seat tighter with use

Rotovalve units accurately control or shut off in hightemperature, high-pressure reactor applications. Units feature lantern ring with double packing, pressurized with the line fluid or purged to a bleed tank at lantern ring.

One example of current manufacturing is a 10-inch Rotovalve unit for operation at 2500 psi, 2500 F. Also being engineered is a 12-inch size for service at 4000 psi, 4000 F. Still another type combines a pair of valves within a single housing for use on dual, concentric pipes. Inner pipe carries 1400 F CO₂ to reactor; outer, 700 F CO₂ away from reactor.

Your Allis-Chalmers representative can arrange reactor valving engineered to your specific requirements. He also supplies a complete line of butterfly valves, including models for air-lock valving. Contact him for detailed information, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Ratovalve is an Allis-Chalmers trademark.



Duplex Rotovaive unit features a single operator — controls 1200-psi, 600 F steam, or 1500-psi, 300 F air. Operator allows both valves to open simultaneously, or one to open while the other closes. Saves space vital where entire reactor unit must be enclosed in radiation-proof structure.

Crew 2—two men working below first, finish welding and bolting-in.

Man at top of tower handling materials.

Man operating hoist and miscellaneous outside.

Second tower—removing old trays:

Leaderman.

Four men inside tower, cutting.

Two men at tower top.

Man handling materials.

Man operating hoist and

miscellaneous outside. Second tower—installing new trays:

Leaderman.

Crew 1—Top, two men tacking in support rings and positioning side panels.

Crew 2—Top, two men below first, finish welding and bolting-in.

Crew 3—Bottom, two men tacking in support rings and positioning side panels.

Crew 4—Bottom, two men below first, finish welding and bolting-in.

Man at top of tower handling materials.

Man operating hoist and miscellaneous outside.

▶ Internal Details—A word of

explanation regarding the detail of the internal work should be given. The old trays were #-in. steel with 2-in. angle rolled around the circumference. A 2-in. ring was to be left as support for the new trays which were designed for clamp-on installation. These supports were not left for the entire circumference of the tower as the old tray was removed completely in the downcomer and seal pan positions. All major pieces of the new trays are clamped to light support rings or bars which are themselves welded in. The clamps are simple J-type clamps. These clamps are assembled to the panels before they are sent into the tower and then, after the panel is positioned, are simply tightened a few turns to complete the installation.

What We Did—First, the tower was removed from service and depressured. Then pipefitters removed pressure relief valves and installed steam and water connections for purging of the vessel. The tower was filled with water to float out any remaining absorption oil, drained, steamed for 12-hr. and again filled with water, primarily for cooling, and drained.

Three crews began removing each of the two external manways and the tray manways. Once the internal manways were removed and an okay was given by the safety engineer to begin cutting, two welders, starting on the top tray, began cutting the old trays into sections small enough to pass through the 18 in. manways. These pieces were removed through the top of the tower and lowered to the ground.

On the second tower, where we had two removal crews, the trays cut by the top crew left through the top manway as before. But pieces cut from the bottom section were lowered through the internal manways and removed at the bottom of the tower.

Preformed steel rungs were tacked to the inside of the tower to give access to the trays after the top tray was out.

Once all old trays were out and only the shell and support rings for the new trays remained, installation of new trays started at the bottom of the tower and progressed to the top. Two crews worked inside the first tower on this operation. The first crew tacked in the supports for the new trays and positioned the two outside panels and seal pan. With three trays thus partially installed, a second crew of two welders, working below the first, finish welded the supports and tightened the clamps.

On the second tower, however, two crews worked in the top section while simultaneously two crews in the bottom section performed these same functions. When the crew in the bottom section completed the installation of its new trays, they cut out the one remaining old tray and installed the last of the new trays.

Installation of a wire mesh mist extractor and thorough inspection of each finished tray completed the job except for placing the tray manways and closing the tower.

▶ Room for Improvement—We found several areas for improvement after completion of the first job. The converted shop fan used for ventilation was not enough to remove the smoke and heat generated in the tower during cutting operations. So on the second tower we used three

Compare Times for Retraying Two Towers—Table I

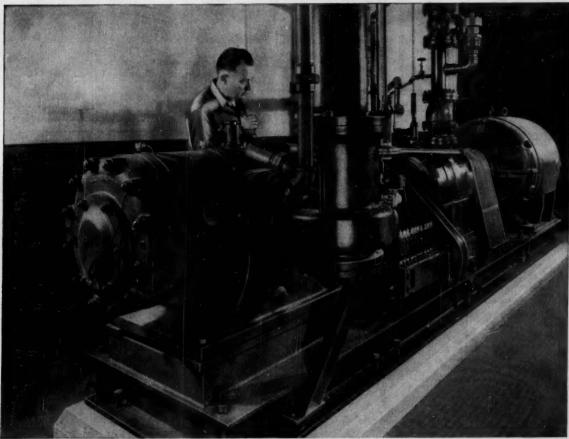
Operation	1st Tower (1 Crew)	2nd Tower (2 Crews)
1. Depressure, wash, steam	24 hr.	24 hr.
2. Open top and side manway	3 hr.	1.5 hr.
3. Remove internal manway	0.31 hr./tray	0.26 hr./tray
4. Cut out old trays		
Top 11 trays Bottom 10 trays¹ Over-all	3.6 hr./tray	2.6 hr./tray 3.3 hr./tray 1.7 hr./tray ²
5. Install new trays		
Top 11 trays	2.4 hr./tray	2.8 hr./tray 2.6 hr./tray 1.6 hr./tray *
6. Internal manway installation	0.35 hr./tray	0.28 hr./tray
7. Inspection	5.5 hr.	5.5 hr.
8. Close tower, pressure-up	4.5 hr.	4.0 hr.
9. Over-all elapsed time	7.7 days	3.9 days

¹One tray removed at earlier date.

²Two crews working, in part simultaneously. Beginning and ending times were not concurrent; therefore, over-all time cannot be arrived at directly from top section and bottom section times.

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no new parts for this RO-FLO compressor since installation

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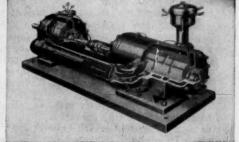
It hasn't let them down. It's been operating 24 hours a day,

It hasn't let them down. It's been operating 24 hours a day, six to seven days a week, with no major stoppages and no new parts installed since the initial start-up three years ago.

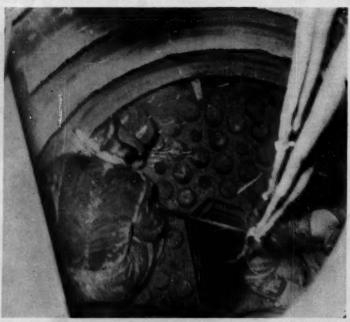
Ask your A-C representative about low-noise, low-maintenance *Ro-Flo* compressors. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

Industry's most complete line of rotating-type compressors





Silding-vane action compensates for blade wear, helps maintain constant efficiency. Rotary motion cuts vibration and noise, eliminates shock and the necessity for expensive foundations. Ro-flo is an Allis-Chalmers trademark. A-1306



WELDERS cutting out old trays. Note support rings left in, internal manways in trays and cables from overhead hoist for removing scrapped trays.

1600-cfm. blowers. One was mounted on a 6-in. nozzle near the middle of the tower and the other two were hinge-mounted on the top and bottom manways. Thus we could swing the fans out of the way as necessary for the entry of men and materials.

If a platform were available on top of the tower, old tray sections could be stacked there temporarily, to be lowered later in a batch. So we built a scaffold completely around the second tower and constructed a wooden bin at the top. When all of a tray was stacked on top, the lot was lowered to the ground while the men inside removed the next tray.

Locating the weld-in pieces for the new trays was one of the most time consuming parts of the entire operation. To reduce the time we made wooden locating jigs for items with critical dimensions.

In the first tower rusty scale hampered the cutting operation by causing sputtering and popping. To minimize this effect in the second tower we loosened the scale on the cutting areas with wire brushes on portable air

grinders. Then we removed the residue with an industrial vacuum cleaner capable of picking up # x 2 in, bolts thus leaving a clean cutting area. The vacuum cleaner also proved a great timesaver in removing slag and trash from new trays after they were installed.

Cut Down Time by Half-Table I compares the time for the first and second jobs. The largest single timesaving resulted from division of the tower into two working areas with separate groups working inside each section at the same time.

But the following also proved themselves to be timesavers in such jobs.

1. Schedule all operations before actually beginning work and assign each man or crew to a particular job or jobs. Make these schedules available to individual workmen and leadermen in a usable form, detailed enough to specify what each man should be doing at all times.

2. Divide the tower into two or more working sections as entrance manways permit. Provide absolute overhead protection to the lower crew.

3. Provide adequate forced ventilation—the more the better.

4. Simplify materials handling with numbered containers.

5. Eliminate lost motion. A good example of eliminating lost motion is reduction of idle time of the inside crew while hoisting old tray sections from inside the tower.

6. Provide labor and timesaving devices such as air wrenches, power brushes and vacuum cleaner for cleanup.

7. Thoroughly familiarize all personnel with the work by setting up one of the new trays outside the vessel before beginning the job. Many timesaving suggestions will come from the workmen themselves.

8. Before beginning work, make cutting templates and spacing jigs for locating new parts without excessive measur-

ing.

9. Schedule inspections to coincide with shift changes or meal breaks, whenever possible.

This job reaffirmed the old adage that four men working two days can do as much work as two men working four daysprovided they do not get in each other's way. If down time is expensive, it pays to put as many men on the job as is consistent with efficiency.



JAMES TIPTON is a project engineer with Texas Gas Corp. at Houston, where his responsibilities include process and economic evaluations, product quality control and coordination of staff originated projects with plant operating people.

Mr. Tipton attended the Univer-

sity of Texas and the University of Houston. He received his bachelor's degree in chemical engineering from the latter institution in 1958.





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Sizes: 1/2" through 30".

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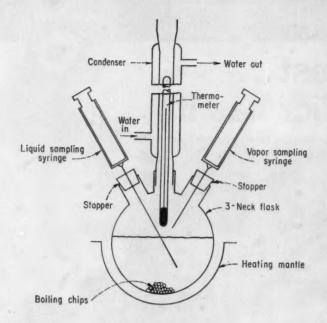


DIVISION OF OCT INDUSTRIES

INCORPORATED

P. O. BOX 2117, HOUSTON, TEXAS

ROCESS DESIGN NOTEBOOK EDITED BY T. R. OLIVE



"Hypodermic Still" Provides Source of Vapor-Liquid Data

Low in cost and simple to operate, this still makes it easy to get needed distillation data.

* Winner of the May Contest by

Paul J. Horvath

Development Engineer, B. F. Goodrich Chemical Co., Avon Lake, Ohio.

Often, because of the lack of published data, or because of the need to verify data, the chemical engineer finds need for experimentally determining vaporliquid equilibrium compositions. There are many types of apparatus available for doing the job but almost all of them are expensive, complex, difficult to operate and need lengthy runs to be certain of reaching equilibrium.

We have developed a simple still which costs little, yet is easy to operate and needs little time to reach equilibrium. This still, shown in the sketch above, consists of a standard round-bottom three-necked flask of 3 liter capacity, provided with an electric heating mantle or jacket. A water-cooled Liebig condenser is mounted on the center neck, with a thermometer hung in the con-

denser so its bulb is just above the liquid level in the flask.

Each of the two side necks is fitted with a rubber or cork stopper through which a hypodermic needle is inserted. One of the needles extends down into the liquid, while the other is fitted about an inch above the liquid.

Secured to each needle is a small hypodermic syringe with a capacity of about 2 to 5 cc. Boiling chips are added to the flask to minimize superheating. Since vapor can not flow into the vapor sampling syringe until a sample is taken, it is not necessary to provide the vapor line (hypodermic needle) with any heating devices to prevent undesirable condensing and refluxing. Thus, the possibility of introducing superheat through artificially controlled vapor temperatures is eliminated.

To operate the apparatus, we charge about 2 liters of liquid of the approximate desired liquid composition to the flask. The mixture is then heated until it is refluxing gently. Since the amount of liquid in the flask is large compared to the amount that is refluxing, the "batch distilling" effect is minimized.

After about 5 or 10 min. of gentle refluxing, the vapor sampling hypodermic syringe plunger is withdrawn, creating a vacuum in the syringe so that the vapors above the liquid rush into the syringe where they condense, since the syringe acts as an air-cooled condenser. To minimize the change in liquid and vapor composition during the sampling, only about a 2 cc. sample is withdrawn. The remaining liquid in the flask is then sampled with the liquid sampling syringe. Both samples can then be analyzed in any conventional manner.

Using this technique we have been able to determine as many as eight V-L-E points in one day. Comparison of our results with published data shows that this still gives surprisingly accurate

(Continued on page 146)

Which of these 3 products and services can yo



What's new in Metal Treatments and Etching?

Quite a few things. For example, there's the use of Becco Am-monium Persulfate in etching printed circuits. Seems the ma-terial works a lot better - at less cost - and with none of the hazards of the ferric chloride solutions conventionally used. Then, there's the problem of

pickling copper and brass. Lots of pickling agents will do this — only trouble is, you've got to paint or plate or do whatever you're going to do with the metal rather quickly. Or else. Or else it will tarnish oxidize and you're in the pickle

all over again. Not so with Ammonium Persulfate. Cleans fine. Puts a mild etch on the surface, too, for better paint or plating bonding. More important, perhaps, is the fact that the metal resists retarnish-

ing for up to two weeks. Ideas? We hope so. What's more, we've got several booklets to help spur you on. They're free-use the coupon below to order.

- No. 39 and 51-Surface Treatment of Metals with Peroxygen Compounds.
- No. 86 Improving Properties of Copper and Brass Surfaces.
- No. 97 Paddle Etching of Printed Circuits with Ammonium Persulfate.
- No. 99 Tank Immersion Etching of Printed Circuits with Ammonium Persulfate.
- No. 102—Etching of Printed Cir-cuits with Mercury Ac-tivated Persulfate.



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We have a good number of such compounds on the shelves. Quite a few others are in development. Still others are merely in our minds, but we can begin drawing them out if you're interested.

We hope you are interested. But we'll never know-unless you fill in the coupon below and mail it to us. Why not?

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Send me more information about Becco Peroxygen Chemicals.

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ADDRESS.

STATE

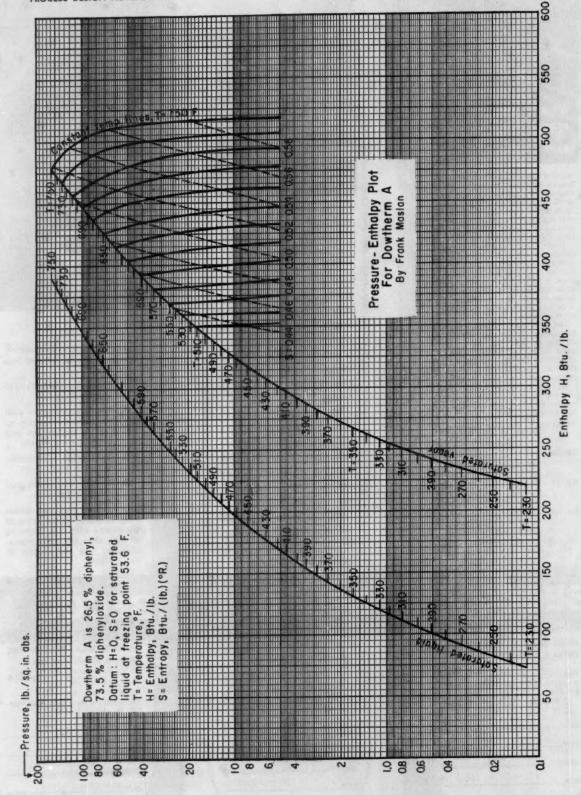
Station B. Buffale, New York

Please tell me more about your Four-Fold Engineering Service.

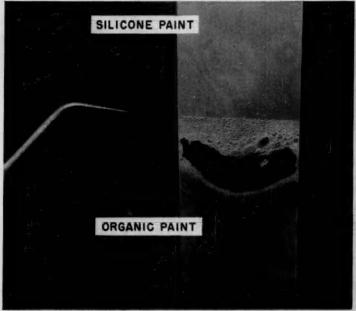
BECCO CHEMICAL DIVISION, FMC

ADDRESS.

STATE



New Paint For Hot Spots



Silicone-based paints stay put ... resist corrosion, weathering

Guarding metal surfaces from weathering and chemical attack is tough enough. Keeping them protected when surface temperatures climb to 700 F, 800 F - even 1000 F - is tougher still. Most paints fail rapidly, blister and peel. But paints based on Dow Corning Silicones retain their protective properties, even on the hottest jobs.

Whether the surface stays hot, or shuttles between hot and cold, makes no difference to a silicone paint. Here's a new kind of protective coating . . . one that you can depend on to provide real protection, withstand oxidation, corrosive atmospheres or weathering. When paint lasts like this - from 25% to 100% longer - you save money because (1) less paint is required; (2) costly downtime and labor are greatly reduced.

Another plus: Silicone-based paints are available in a wide range of colors. This means you can carry color-coding over onto hot equipment without worrying about early paint failure. To new product designers, this feature means finishes that resist chalking, checking, fading - retain their original beauty and protection.

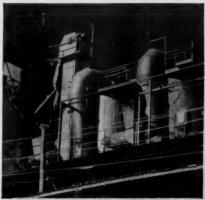
For protecting a "hot spot" or a "hot product", it'll pay you to use paints made with Dow Corning silicone resins. Write today for more information.



"After 5 years, silicone paint still protects bronze-melting furnace. Organic paints failed within days after application."



"After two years, mufflers coated with silicone paint are still in good shape. Organic paint used on similar 500 F mufflers burned away long ago."



"By far the most satisfactory paint we have ever used on kilns and stacks with surface temperatures of 650 to 750 F." BASIC CHEMICAL MANUFACTURES

Send for illustrated brochure, "Why Silicone-Based Paints Mean Less Maintenance", plus list of suppliers. Address Dept. 1807.



Corning CORPORATION

MIDLAND, MICHIGAN

results, considering the simplicity of design and operation. We have found it particularly useful for handling systems which form two phases upon condensing. In this case, the vapor sample is taken as before and the resulting two-phase condensate is then discharged into a weighed amount of a mutual solvent, which can then be analyzed by conventional means.

We recognize that this still operates on the assumption that the vapor obtained by boiling a liquid is in equilibrium with the liquid. Although this assumption may not be valid for all systems, it can be used for a great many cases with results of sufficient accuracy to be of real value in subsequent distillation calculations.

Pressure-Enthalpy Plot For Dowtherm A

Frank Maslan

Brookhaven National Laboratory Upton, L.I., N. Y.

Dowtherm has long been used as a heat-transfer medium but a complete thermodynamic plot has not been available. This laboratory has now plotted the pressure-enthalpy diagram on p. 144 for the regions for which Dow Chemical Co., Midland, Mich., has provided data in the "Dowtherm Handbook" (1954).

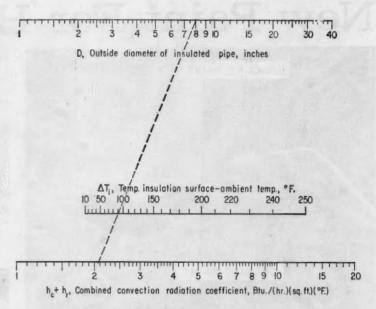


Chart Finds Heat Loss Rate

J. F. Kuong

Atlas Powder Co., Wilmington, Del.

In calculating the heat loss to the air from insulated surfaces, both the heat convected and that radiated to the surrounding air must be taken into account. An easy way to get at this is to estimate a combined heat transfer coefficient for both convection and radiation by means of an empirical formula proposed for horizontal insulated pipes by Heilman (*Trans. ASME*, 44, 308, 1922). This formula is:

$$h_e + h_\tau = \frac{564}{(D^{0.19})(273 - \Delta T_i)}$$

where D is outside diameter of insulation, inches; $h_* + h_*$ is the combined convection-radiation coefficient of heat transfer, Btu./ (hr.) (sq. ft.) (°F.); and ΔT_* is insulation surface temperature minus air temperature, °F.

The nomograph solves this equation for most ranges of the variables. For instance, in the example shown, if the surface temperature of an insulated horizontal pipe 8 in. in diameter is 160 F. and the ambient is 70 F., then ΔT_1 is 90 F. and the combined coefficient is 2.07.

Coming August 22: Rolls Make a Good Feeder

By Sam A. Jones, Winner of the June Contest

* How Readers Can Win

\$50 Prize for a Good Idea—Until further notice the Editors of Chemical Engineering will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebooks. Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

\$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize. How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates (\$10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, Chemical Engineering, 330 W. 42 St., New York 36, N. Y.

Correction—J. M. Uys of Natrona Heights, Pa., has called our attention to a typographical error on p. 162 of our May 16, 1960, issue where an expression should have appeared as $d=0.0243 \sqrt{W}$ and not as $d=\sqrt{0.0243 W}$ as printed.

HALLIKAINEN ANNOUNCES... Boiling Point Analyzers:

initial to 10% and below 90% to end point

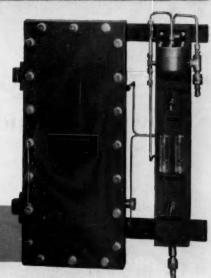
give

Immediate tower control, manual or automatic

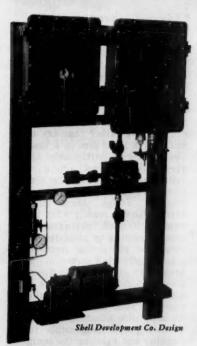
for

Lower control costs Better yields Uniform production

Pay out 30 to 60 days



Shell Development Co. Design



Other Hallikainen Products:
Cominuous Vaper Pressure Analyzer, sumples
vaper pressure in stream—Continuous Viscometer, reduces lab analysis, gives better
control—Suffyric Acid Analyzer for suffuria
acid alkylation plants—Continuous Color Anatument Michig for Hearnture.

MANY SAVINGS come your way when you say Goodbye to hand sampling and laboratory analysis of tower output.

With the refinery-proved Hallikainen-Shell Boiling Point Analyzers, you are certain of lower control costs, better yields and uniform products that always please customers by meeting specifications.

In that way, these new instruments pay out in 30 to 60 days. After that, the savings show up every month in lower costs for

One instrument can be adapted to record either the initial boiling or the 10% point (200° to 400° F). The other, can be set from below 90% to the end point (200° to 600° F), Both monitor

continuously.

Corrections in the tower can be made immediately—either manually or by an automatic signal fed into the tower control. Compare that with the tower stream going wrong for hours before the usual lab analysis can detect it!

These Hallikainen Instruments
—proved accurate, reliable and
safe—operate with a constant
sample flow. Aside from changing
the recording chart daily, little
attention or maintenance is

Write for all the technical facts on the Hallikainen-Shell Boiling Point Analyzers and then decide for yourself how these instruments can save money for your refinery.

HALLIKAINEN

1341 Seventh Street

Berkeley 10, Calif.

Phone: LAndscape 4-1757

CORROSION-CONTROL DESIGN

5a

Part of a series appearing throughout 1960

How to Extend Storage-Tank Life

Proper tank location, insulation, stressrelieving, regardless of the material of construction, go a long way towards putting more life in storage tanks.

C. K. ALDRICH, Consulting Engineer, Buttzville, N. J.

A first consideration, from a corrosion standpoint, in the design of storage vessels involves materials of construction. Given a liquid of known corrosivity, a choice will usually be based on the cheapest material which will provide a desired service life. In cases where product purity is important, more resistant and costly materials would be called for.

However, adequate troublefree service life does not depend solely on construction materials. All too often the best materials (chosen on the basis of extensive testing) fail prematurely due to neglected design considerations. According to electrochemical theory, for corrosion to proceed, there must be an electrolyte contacting an anode and a cathode, which in turn are connected by an exterior metallic circuit. In storage tanks the liquid being stored is the electrolyte and the vessel wall provides the external circuit. Points of differing potential on the metallic surface provide anodes and cathodes.

It is our purpose to discuss factors which either promote the occurrence of such local anodes and cathodes or cause abnormal corrosive conditions and show how they can be minimized by proper design. External Corrosion — The great majority of storage tanks are located outdoors and atmospheric corrosion is a prime cause of failure. To minimize such failures, tanks should be located to windward of cooling towers, stacks or fume vents discharging corrosive vapors. It could well prove economical to provide extra piping rather than try to maintain a paint film in a location having a particularly aggressive atmosphere.

Rain washes off corrosive contaminants and this is beneficial. However, design should allow surfaces to dry readily when the weather is good. For instance, areas protected by platforms or structural supporting members are subject to corrosion or breakdown of paint films due to slow evaporation of moisture in a confined space. Once corrosion starts in such areas, they offer an impossible situation to maintenance people responsible for cleaning and painting the equipment. Many situations of this type cannot be avoided; but design should minimize them.

► Aluminum Paint—A painting system for the outside of tanks,

. Future Articles

Design of heat exchangers to minimize corrosion.

Design of mixers to minimize corrosion.

^{1.} Plant Site, Layout Minimize Corrosion, Jan. 11, 1960, p. 144.

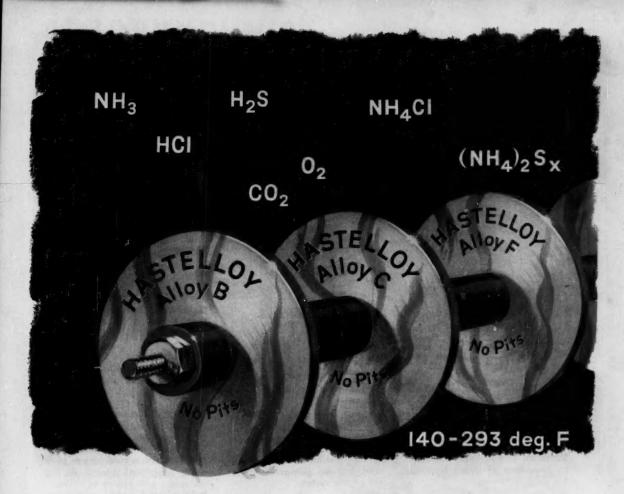
^{2.} Proper Design Voids Equipment Corrosion, Feb. 22, 1960, p. 162.

³a. Often Overlooked Reactor Design Factors, May 2, 1960, p. 150.

³b. Keys to Corrosion-Wise Reactor Design, May 16, 1960, p. 170.

⁴a. Valve Design: Special for Corrosives, June 13, 1960, p. 238.

⁴b. Valves for Severe Corrosive Service, June 27, 1960, p. 146.



Pitting Corrosion a Problem? ...Test HAYNES Alloys

No pitting from chlorides . . . and less than 1 mil per year penetration . . . on HASTELLOY alloys B, C, and F! These were the results of on-stream tests at six locations in the low-temperature zone of a hydrocarbon bubble tower.

Yet ten other alloys tested showed extensive pitting . . . and corrosion rates up to 15 mils.

Send for test samples

Have you perplexing corrosion problems in

your processing equipment? To help you solve them, we have been testing, developing, and perfecting corrosion-resistant alloys for thirty years. We'll gladly send you free samples of HAYNES alloys for you to test yourself.

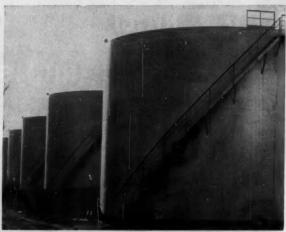
To be sure you receive the alloys most suited to your needs, please send us as much data as possible about the corrosion problem involved. Ask for a copy of our booklet on HASTELLOY alloys. Write us at 270 Park Avenue, New York 17, N. Y.

HAYNES

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation Kokomo, Indiana UNION CARBIDE

"Haynes," "Hastelloy," and "Union Carbide" are registered trade marks of Union Carbide Corporation.



Humble Oil and Refining Co

Storage-Tank Design Factors Increase Longevity

Locate tanks so stacks or fume vents are not discharging corrosive fumes on equipment.

Minimize atmospheric corrosion by providing adequate drainage for rain water.

Overcome stress-corrosion cracking by specifying a stress-relief heat treatment. Avoid intergranular corrosion by choosing stabilized or extralow-carbon stainless steels.

Insulate dissimilar-metal components (valves, pumps) from the rest of the system.

Watch out for vapor-phase corrosion in storage tanks, which can be avoided by insulation.

which gives long periods of protection, consists of two coats of a red-lead primer, followed by two coats of aluminum paint—the composite coating should have a minimum thickness of 5 mils. This is good for general industrial atmospheres.

It should also be mentioned that aluminum paints, based on epoxy esters, are now available that remain bright and untarnished for long periods.

Severe chemical atmospheres call for more resistant coatings, applied with meticulous attention to surface preparation, weather conditions during application, compatibility of primer and finish coats, technique for applying the coating, etc.

► Tank Bottoms—External corrosion of tank bottoms can also be a serious problem. If the tank is supported on the ground, the material forming the pad can contain corrosive compounds. Cinders, for example, contain sulfur compounds, and clay in a sand pad can cause pitting. The key point here is: provide adequate drainage to prevent water accumulation.

For tanks supported above ground, the space between tank supports should be sealed, or other provisions made, to eliminate moisture collection.

► Interior Corrosion—Now let's consider the interior of storage tanks. Stainless steel (solid alloy or lining) is a popular material

of construction for tanks handling corrosive materials. Often, such tanks are connected to stainless piping.

However, some words of warning are in order on chromiumnickel steels. For instance, Cr-Ni stainless may be seriously damaged by surface scratches or surface contamination, which destroy the protective-oxide surface film.

Contamination can be caused through use of nonstainless tools, which leave particles embedded in the surface, or deposits of dirt, dust or other foreign material.

The effect of air-borne deposits is illustrated by some stainless-steel piping which had been stored in the yard of a chemical plant. This piping, although never used, became pitted. Attack was caused by aggressive components of the atmosphere acting under flecks of fly ash which had settled on the surface.

It is good practice to specify a suitable cleaning or passivation treatment for stainless-steel tanks before they are put in service. It is also a good idea to keep such equipment sealed during shipment and before erection.

Stainless Cracks—A number of alloys are subject to stress-corrosion cracking, including aluminum, copper, mild steel, stainless, Monel, nickel, Inconel and titanium. It can be trouble-some in storage tanks.

For stainless, chlorides in any concentration, even a few parts per million, are a potential hazard. Wherever such weak solutions concentrate in stressed areas (in crevices or under surface deposits) transgranular cracking can develop.

Chloride stress corrosion has even resulted from handling of equipment before it was placed in service. In one case cracking of welds in 304ELC steel was caused by concentration of water, used for hydrostatic testing, during a somewhat lengthy period which elapsed between the time of testing and plant startup. Cracking occurred in the crevices formed when tubes entering the vessel were welded on the outside of the tank shell.

The problem of stress-corrosion cracking in storage vessels

CARBORUNDUM'S

 Data sheet

Choosing materials for

CORROSION RESISTANCE

Though seldom associated with resistance to corrosion, certain refractories made by Carborundum outlast and outperform other materials of construction—as the table below indicates.

These special refractories withstand many gases, acids, salts and molten metals. They can be used as small, specialized parts or as complete hearths, walls, and roofs of large furnaces and other processing equipment, (see pictures at right).

In addition to essential corrosion resistance, these unique refractories withstand temperatures of from 2800°F to over 3000°F, carry heavy imposed loads, and are virtually unaffected by abrasion.

The tables below offer a very rough guide to properties and applications. Feel free to call on Carborundum for more comprehensive data that can be used in solving your particular problem.



Arch, jambs and sidewalls of CARBOFRAX® silicon carbide in this aluminum reverberatory furnace have resisted attack by corrosive molten aluminum for more than two years.



These parts of REFRAX® nitride-bonded silicon carbide, a Carborundum refractory, have exceptional resistance to corrosion. They are made in complex and accurately dimensioned shapes. Adapted to many installations, REFRAX shapes frequently outlast expensive alloys.

TYPICAL APPLICATIONS INVOLVING SEVERE CORROSION

- Generators handling superheated steam, oxygen and pulverized coal
- Aluminum reduction cells
- · Rock wool furnaces
- Wire guides and blocks in pickling tanks

ACIDS (Heated) HHO3 H₂SO₄

- Mannheim furnaces
- Hydrogen chloride burners
- Multiple hearth roasters, also rabble blades and teeth
- · Artificial gas generators
- · Spray nozzles
- Aluminum furnaces and pumps for molten aluminum
- · Sinker rolls for aluminizing
- · Acid slurry pumps
- Incinerators
- · Slag bottomed boilers

CHEMICAL	RESISTANCE G = Good	OF TYPICA	NR = Not recor		Aluminum
	Silicon carbide	Aluminum		Silicon carbide	oxide
MOLTEN ME		G	ACIDS (Heated H ₃ PO ₄ HCI)—Contd. F G	G
Sb Cu Fe Mg	G NR F NR	G	GASES CO ₂ H ₂ O O ₂	G	GGGG



Write today for your free copy of "Super Refractories by Carborundum." The address: Dept. H-70, Refractories Division, Perth Amboy, N. J.

... acid-storage tanks inside buildings are far less subject to vapor-space corrosion than those outside ...

can usually be overcome by specifying a suitable stress-relief heat treatment. Such treatment is only effective after complete fabrication. Subsequent weld repairs will probably call for a reheat.

A case in point concerns a large steel tank used for storage of light oil that had been subject to a caustic wash. After several years of service, a nozzle was welded to the bottom of the tank where the steel was contacted by the alkaline aqueous phase. Within a short time leaks developed through cracks in the heat-affected zone. It was necessary to make repairs by rewelding and then have the entire structure stress relieved.

In the case of austenitic (300 series) stainless steels the problem of stress relief becomes rather complicated. At a usual stress-relieving temperature, say 1.250 F., these steels are subject to sensitization (chromium carbides in the grain boundaries) which results in very serious intergranular corrosion. Fortutunately this tendency toward sensitization has been largely overcome in the stabilized (321 or 347) and extra-low-carbon grades. These grades should be specified for welded equipment. ► Avoid Stresses—Other factors to consider in reducing stresses: proper alignment of connecting piping and strength to resist normal handling during shipping and installation. Alignment of piping is important in preventing over-stressing of nozzles. Vessel strength as a whole must be sufficient to withstand deformation during shipping and installation which may result from the use of slings, prys, localized supporting members, etc.

▶ Dissimilar-Metal Problems— Where it is necessary to use dissimilar metals, such as high-alloy valves or pumps connected to a steel tank, the designer should consider the following:

 Avoid connecting widely separated metals in the galvanic series, since the less noble metal will rapidly corrode in such a coupling.

· Area ratios are important. Combination of a large anodic area and a small cathodic area will not, as a rule, produce serious corrosion. The opposite combination can result in rapid failure. Corrosion also depends on conductivity of the electrolyte. Where conductivity is low, even though the anodic-to-cathodic area ratio is favorable, the galvanic current may be confined to the immediate vicinity of the cathode and serious corrosion can develop. Also, when a tank is emptied a pocket of solution may be left contacting dissimilar metals such as a brass bushing in a steel coupling. Such a condition also serves to confine the corrosion current to a small anodic area.

It is sometimes expedient to insulate certain dissimilar-metal components such as valves, pumps and piping from the rest of the system. This breaks the galvanic circuit and corrosion cannot proceed. Non-conducting elements consisting of plastic bushings, gaskets, bolt sleeves and washers are available for this purpose. If galvanic corrosion is to be controlled by this method take care to see that there is no electrical connection between the two parts of the system via supporting structural steel or another external metallic path.

► Watch Vapor Phase—Many times a liquid medium, which in itself is not particularly corrosive, may cause trouble in the vapor space. This is particularly true of sulfuric or mixed-acid storage tanks.

During normal changes in ambient conditions, tanks breathe; moist air is drawn in and when temperature conditions are right moisture condenses on the walls in the vapor space resulting in a corrosive weak-acid condition. Such corrosion is accelerated by alternate heating and cooling when the tank is exposed to direct sunlight.

The author has observed that acid-storage tanks inside buildings are far less subject to vapor-phase corrosion than those located outside. From this point of view it should prove economical to reduce internal temperature changes by insulating or decking over to keep off direct sunlight.

It may also be possible to prolong the useful service life of a storage tank if it is designed so that it can be inverted when the corrosion allowance in the vapor space is used up.

Second Article Coming—The second article on storage-tank design will appear in the next issue and will discuss how to handle heating coils, linings, flanged connections and gaskets, and drainage to minimize corrosion.



CHARLES K. ALDRICH has been connected with corrosion work for over 25 yr. He joined International Nickel after studying at Worcester Polytechnic. In 1945 he started working for American Cyanamid and since that time has been involved in inspection of equipment and diagnosis of corrosion problems in various Cyanamid plants, as well as testing and evaluating protective coatings. From 1956 to 1960, he was connected with Chemical Construction as a corrosion and materials engineer in Chemico's pilot-plant at North Brunswick, N. J.



This Class 600 Marley Double-Flow cooling tower is one year old . . . and in excellent condition functionally, mechanically and structurally. To assure many more "happy" anniversaries over a long future, The Marley Company will never relax vigilant attention to every detail of its welfare.

Like all Class 600 towers, it will be under the surveillance of a member of the Marley Service Engineering staff, experts on cooling tower operation and maintenance. The results of their services are best attested by supervisory engineers and executives in plants where Class 600 towers are now in service:

ENGINEER, GENERATING STATION:

"We have greatly appreciated the service you have rendered. We had little experience with towers before these four units were put in operation, but we have received much help from your service engineer. Periodic inspection by someone who knows towers relieves us of the worry of letting our towers degenerate. Our supervisors always look forward to these visits and have plenty to discuss with your engineers. Your service has been good and we hope we can continue along this way with the new tower which you will soon be building here."

MANAGER, NUCLEAR PLANT:

"It is our opinion that mutual benefit has been derived from the periodic visits of your service engineer. We know that this service has given us experienced

assistance in operational, mechanical and wood deterioration problems."

REFINERY ENGINEER:

"The Marley service engineer has been a most helpful person to work with and has always been ready to come and help us. His recommendations have been fair, honest and unbiased. That is why we have always accepted them. We would be very disappointed if this service was not available; we have come to depend on it."

MUNICIPAL POWER SUPERINTENDENT:

"From the power plant operator's point of view this is the best service you can give! I will welcome your service engineers at all times. There are many pieces of equipment in a power plant and it is impossible to give each piece of equipment the loving care that the manufacturer would like it to have. Therefore, I welcome an opportunity to discuss, with service engineers, the operation and maintenance of any piece of equipment in the plant. Your service engineers have been most courteous and helpful. I hope that I shall see more of them in the future."

PETRO-CHEMICAL PLANT MANAGER:

"We have found the attention of Marley service engineers beneficial to our cooling tower operation and maintenance. In particular, we appreciate the latest inspection of our towers. This service has been helpful to our preventive maintenance and cooling tower repair programs. We are looking forward to working with your engineer during an early visit."

THE MARLEY COMPANY



KANSAS CITY, MISSOURI

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

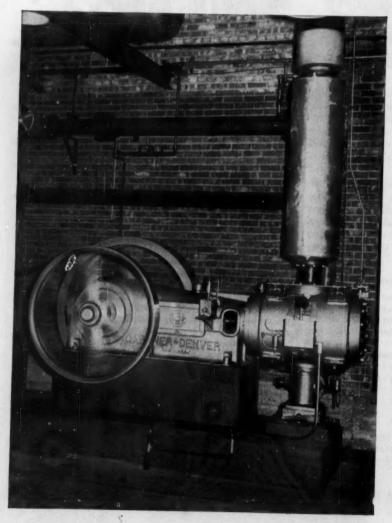


GARDNER DENVER

For continuous compressed air power, install the Gardner-Denver RX compressor. It assures years of reliable service . . . requires only routine attention. The sturdily engineered, dirt-free power end—that's one reason. And behind the scenes at Gardner-Denver, cleanliness in every step of assembly is another key to endurance. Rigorous testing assures years of efficient, trouble-free performance. Get the full story on RX superiority for 'round-the-clock service. Write for Bulletin HAC-40. Gardner-Denver Company, Quincy, Illinois.

Built for the long run

Gardner-Denver RX



INDUSTRY NEWS . . .

(Continued from p. 72)

kraft paper per year. It will occupy a 640-acre tract of land.

Oronite Chemical Co., subsidiary of Standard Oil Co. of Calif., will more than double its capacity for producing polybutene. Company will build a new polybutene unit and expand two existing units at its Richmond, Calif., refinery for a total cost of \$3.4 million. When the new equipment is on stream, probably next year, Oronite will be world's largest producer of polybutene.

Aluminum Co. of America has announced plans to expand and modernize its two major sheet mills. One is at Davenport, Iowa, and the other is at Alcoa, Tenn. Total cost will be over \$18 million. Initial spending will begin this summer, and the company expects that the construction program will require two years. Twofold aim of program is to gain greater rolling capacity and to improve production methods by incorporating recent advances in technology.

Cranberry Iron and Steel Co., a recently-formed firm, will put up an electric smelting furnace operation to make sponge iron and high-grade steel in Carter County, Tenn. Furnace will cost \$4 million and reportedly will be the only one of its type in the U.S. It will receive 400 tons of ore per day from the nearby Cranberry iron mines in Avery County, N. C., which have been reactivated after being idle for 25 years. The mines are operated by the Cranberry Magnetite Co.

U.S. Steel's Columbia-Geneva
Division is constructing an
iron ore mining and benefication facility 26 miles south of
Lander, Wyo. Located at an
altitude of 8,300 ft., it will be
the highest large-scale open
pit mining operation in the
U.S. Capacity reportedly will
be about 4,000 tons of highgrade iron ore pellets per op-

erating day. Pellets will be sent to Columbia-Geneva's integrated steel plant near Provo, Utah.

Buckeye Cellulose Corp. currently has a multi-million-dollar expansion program under way at its mill in Foley, Fla. The mill produces dissolving and bleached kraft pulps, and the expansion will boost capacity from 260,000 to 293,000 tons/yr. Project is to be completed by next year. This is the third time within five years that Buckeye has increased capacity at its Foley operation.



Stewart-Warner Corp. has installed a new manufacturing facility to make brazed aluminum plate-and-fin heat exchangers at its Indianapolis plant. Company reports that aluminum heat exchangers with 22,000 sq. ft. of heat transfer surface, about three times the size of exchangers previously available, may be dip-brazed in the new facility. Part of the equipment used is the Lindberg-Upton salt bath furnace shown above; it is said to be the largest of its type ever built in this country. The aluminum heat exchangers that Stewart-Warner makes are especially applicable to low-temperature operations.

United Pacific Aluminum Corp., of Los Angeles, plans to build an aluminum reduction plant on the Columbia River near Longview, Wash. Facility will cost \$10 million; it will treat



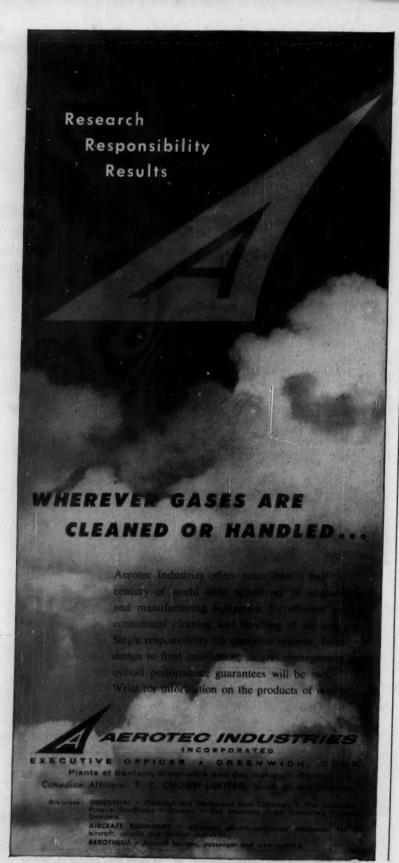
New Impact Wrenches hit harder—last longer

Two new, lightweight, easy-to-use Gardner-Denver impact wrenches hit harder, yet don't wear themselves out. They're the result of intensive engineering to develop a powerful, long-lasting impact mechanism. The combination of a fast-accelerating air motor and a new, patented clutch mechanism assures positive starts, efficient impacting and lowest maintenance. Model 18B-9, 1½" capacity—Bulletin 18-15. Model 18B-7, ¾" capacity—Bulletin 18-11.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW



Gardner-Denver Company, Quincy, Illinois In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario



INDUSTRY NEWS . . .

imported bauxite and ship its output of pig aluminum to the firm's Los Angeles plant for fabrication. Construction is due to be completed next year.

Imperial Sugar Co. has begun installing a six-story, \$500,000 quality control house at its refinery in Sugar Land, Tex. The latest phase of a \$10-million modernization program, it is expected to increase white sugar granulator capacity by 50%, as well as providing a modern and complete brown sugar system. Installation will be complete about Oct. 1. (See also Chem. Eng., May 2, 1960, p. 94.)

Strong Cobb Arner Inc. announces that construction is under way to double manufacturing and laboratory facilities at its Murray Hill, N. J., plant. New or expanded facilities include modern pharmacy, mixing, blending and tablet compression and coating equipment, as well as high-speed packaging lines and warehouse space.

Tennessee Products & Chemical Corp., a subsidiary of Merritt-Chapman & Scott Corp., is expanding its Chattanooga, Tenn., facilities for making Benzoflex plasticizers and other chemical products. Expansion will cost about \$1.25 million, will tentatively be completed early in 1961. The company has also curtailed production of alloy metals at plants in Chattanooga and Rockwood, Tenn., and Houston. Tex.

Allied Chemical Corp. reveals that its National Aniline Division will more than triple its isocyanates capacity at Moundsville, W. Va. The expansion will be a multimilion-dollar project, and is to be completed by mid 1961. Company spokesmen state that although the move will result in short-range excess capacity (industry-wide), the expansion is necessary to insure National Aniline's longrange participation in isocyanate markets.

Stauffer Chemical Co. announces that it is joining with Shell Chemical Co. and Western States Chemical Corp. to form a new fertilizer company. Plans include an over-50,000-ton/yr. plant to supply nitrogen, phosphate and potash solid fertilizers for California and other western states. It will be located next to Stauffer's plant at Dominguez, Calif., and will start operating early next year.



Minerals Engineering Co. has purchased a metals refinery located near Salt Lake City, Utah, and valued at \$1.4 million. Former owner was Howe Sound Co. of New York. Howe Sound used the facility as a cobalt refinery; Minerals Engineering will rather use it to produce vanadium pentoxide, and is setting aside previous plans to construct a vanadium refinery in the area. The firm hopes to be producing commercial-grade pentoxide by the fourth quarter of this year.

Thiokol Chemical Corp. is forming a nuclear unit which will perform research and study on nuclear propulsion for space travel. The new unit is expected to accelerate development activity which has been carried out to date by the company's Reaction Motors Div. and by consultant firms.

Pittsburg & Midway Coal Mining Co. has signed a longterm agreement to supply coal for an electric generating station which the Arizona Public Service Co. is planning to build near Joseph City, Ariz. The station will use an average of 380,000 tons of coal annually, which P & M will supply from reserves in New Mexico. As previously announced (Chem. Eng., June 27, 1960, p. 159), P & M is slated to become a subsidiary of Spencer Chemical Co.

PLASTIC PIPE AD WITH NO PICTURE?

Why no picture:

Because almost all plastic pipe looks the same. You know yourself that looks can be mighty deceiving, and piping that goes wrong can be mighty expensive. A picture means nothing...but...

There are scores of brands of plastic pipe on the market...made of a dozen different kinds of materials. Most of it is labeled "corrosion-resistant" but the results may be good, bad or indifferent depending on your choice. A picture is no help. Here's what to look for instead:

The universal material? No such thing. No one plastic can handle all liquids and gases... no one has all the physical properties required of a truly universal pipe. Closest to it are Ace Riviclor (Rigid PVC) and Ace-Ite (rubber-plastic blend). The former is a little better on chemical resistance, the latter is a little better on impact strength and heat resistance. Both same price.

Are plastics strong enough? Thousands of chemical plants say "yes". Pipe is now available in several wall thicknesses... in flexible tube sizes (Ace-Flex clear transparent), up through gas-tubing sizes (Ace-Ite and Ace Riviclor), through flexible Supplex polyethylene pipe, and Schedules 40 and 80 rigid plastic pipe for pressures up to 490 psi.

Above that, there's Ace rubber-lined steel pipe. And don't forget Ace soft-rubber-lined pipe for resistance to abrasion.

20 valuable pages...comparable properties, chemical resistance, costs, etc. of 11 plastics and rubber materials Write today for Bulletin CE-50.

no less than nine different kinds of pipe ... with fittings and valves to match... and give you thoroughly unbiased advice backed by 100 years of experience and prices as low as you'll find anywhere.

Where do I use it? For corrosive chemicals and gases of all types. The only ones that are difficult are certain solvents and chlorinated aromatic hydrocarbons, and if you're careful to pick the right one of the many Ace materials, you can even handle most of these tough corrosives. Use plastics, too, for water lines, gas lines, electrical conduit, etc., or any lines where the pipe passes through corrosive vapors or damp areas, or goes underground.

Is there a plastic for hot corrosives? Yes, Ace Tempron, which is good to 275 deg. F. with most chemicals. Stays chemical resistant, strong, and rigid where other plastics may be attacked or may sag.

How can I dodge "trial and

error"? Go to a company that has

no axe to grind. We, for instance, make

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SELECTOR
CHARTS
able
see, costs,
materials
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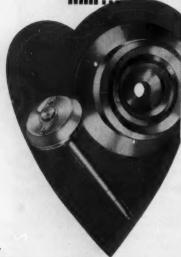
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Contact Premier for complete engineering service on any mixing problem

PREMIER MILL CORP. 224 C Fifth Ave., New York 1, N.Y. INDUSTRY NEWS . . .



West Germany: A new firm known as Hans J. Zimmer Aktiengesellschaft fur Industrieanlagenbau will be formed jointly by Vickers Ltd. of England and the German firm of Hans J. Zimmer Verfahrenstechnik. The new company will engage in plant design, engineering and construction for chemical and man-made fiber industries, and will have its headquarters in Frankfurt. It will be owned equally by the two companies that are forming it.

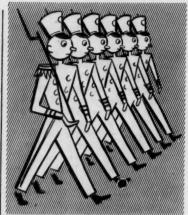
Venezuela: The government is negotiating with Reynolds Metals Co. for construction of a bauxite reduction plant in Guayana. Proposed plant would supply about 15,000 tons/yr. aluminum to the Venezuelan market. Firms other than Reynolds have expressed interest in the venture.

Communist China: Peking radio has announced that a soda ash plant is being built in Sinkiang and will probably start partial production this year. The unit, Sinkiang's first soda ash facility, will have an ultimate capacity of 2,280 tons/yr.

England: Imperial Chemical Industries Ltd. proposes to expand polyvinyl chloride production capacity at its Hillhouse, Lancashire, plant by 10,000 long tons. Move is to be completed by mid-1961.

Italy: SNAM Progetti will design and build a 4,000-bbl./
day catalytic reforming unit for the I.R.O.M. (Industria Raffinazione Oli Minerali) refinery at Porto Marghera, near Venice.

Industry News continued page 160



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WEDGEPLUG STEAM-JACKETED VALVES

... for handling VISCOUS LIQUIDS

Typical Services Where Steam-Jacketed Wedgeplugs Have Outstanding Performance Records

ASPHALT+500° F. — 100 PS!
RESINS+400° F. — 80 PSI
MOLTEN SULPHUR ...+275° F. — 80 PSI
SOFT PITCH+900° F. — 440 PSI

- POSITIVE CONTROL at high temperatures. The Plug lifts, turns and re-seats in one, quick, easy operation. Valve seats are protected; no field adjustment is necessary for varying temperatures.
- NON-STICKING: Because of its protected-seat design, the Wedgeplug Valve will not stick when handling viscous products that harden, congeal, or crystalize at ordinary temperatures.
- NO LUBRICANT USED: Wedgeplug design eliminates the need for expensive plug-seal lubrication—thus saving maintenance cost.
- NO CONTAMINATION: Non-lubricated design eliminates product contamination from grease.
- CORROSION PROBLEMS: Steam-Jacketed Wedgeplugs available in Carbon Steel; and, where corrosion problems might be encountered, can be supplied in various Steel Allovs.
- REMOTE CONTROL: Wedgeplug Valves can be supplied wrench, handwheel, or gear-operated; or, for remote control through use of electric, hydraulic or air motor.

WEDGEPLUG VALVE COMPANY

Division of

STOCKHAM VALVES & FITTINGS

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ABSOLUTE SHUT-OFF AT HIGH TEMPERATURES

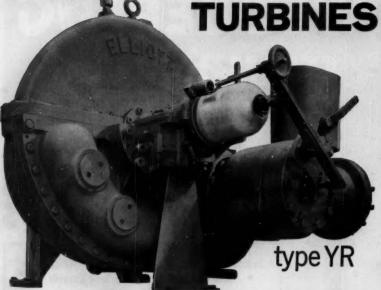
SOLD THROUGH DISTRIBUTOF IN EVERY MAJOR CITY

Specify Wedgeplugs and get the <u>Best Valve</u> for use on lines handling:

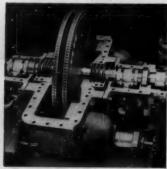
ASPHALT
TAR • PITCH
CRUDE
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RESIN
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Charles and the control of the

ELLIOTT mechanical drive



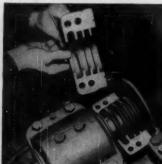
These features mean long life, easy operation



 Smooth and dependable operation at all operating temperatures is assured by the precise alignment of the dynamically balanced shaft.



2. The governor is direct-acting, simple and weather-proof. Separate trip gives over-speed protection. Easily reset against line pressure.



3. Accessible shaft-seals and bearings simplify maintenance and inspection. Covers are readily removable without disturbing the casing.



 Economy at partial loads is secured by the steam-saving hand valve with pilot, which can be opened against full steam pressure.

HO-2

ELLIOTT Company

INDUSTRY NEWS . . .

Yugoslavia: A cellulose factory at Banja Luka, reported as the largest in the country, has gone into production. Operating on beechwood feed, it will produce 40,000 tons cellulose annually.

France: Construction has started on The Firestone Tire & Rubber Co.'s multi-million-dollar synthetic rubber plant at Port Jerome. Scheduled for completion in 1961, it is to have an initial production capacity of 10,000 long tons per year. (See Chem. Eng., May 30, 1960, p. 52.)

Japan: Toa Nenryo, a Japanese subsidiary of Standard-Vacuum Oil Co., has asked for government approval to build a petrochemical plant with its own capital. Plant would cost about \$27 million and would be located at Kawasaki. Annual production would include 62,000 tons ethylene, 39,800 tons propylene, 9,700 tons butadiene, 29,000 tons butylene, 157,000 kiloliters gasoline and 15,000 tons fuel oil.

Canada: A new plant belonging to Liquid Carbonic Canadian Corp. has begun producing oxygen and acetylene. The \$750,000 facility is at Regina, Saskatchewan, and is situated adjacent to a steel mill which is using some of the new plant's oxygen output.

Canada's first plant to produce anhydrous aluminum chloride has been started up in Sarnia, Ontario, by St. Clair Chemical, Ltd. Production capacity is 4 million lb./yr. St. Clair Chemical Ltd. is a subsidiary of the Clinton Chemical Co., of Phillipsburg, N. J.

Syria: The government is building an \$8-million plant to make nitrogen fertilizer near Homs. Construction is scheduled to start around the end of this year, and initial production is targeted for 1964. The plant will go on stream with a capacity of 45,000 tons/yr. but will have an ultimate design capability of making 120,000 tons/yr.



Testing a Rockwood FogFOAM System that guards the oil separator pits in Cincinnati Gas & Electric Co.'s plant.

Here's high protection against low flash-point fires!

In any group of oil separator pits, the pit with the lowest flash point sets the danger mark for the entire area.

To installations of this type—and to many others endangered by fire—Rockwood FOAM and FogFOAM systems bring the surest, most dependable fire protection ever developed.

In the FogFOAM system shown above, protection starts with the heat detectors located around the pits. During any critical temperature rise these

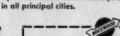
ing any critical temperature rise these detectors sense the inception of fire. The signal is transmitted automatically

and the FogFOAM system goes into instant action.

Rockwood FOAM liquid, mixed with

water and air, is then released through many FogFOAM heads over each pit. Within a few seconds a thick blanket of Rockwood FOAM completely covers the threatened area . . . A disastrous fire has been prevented.

Fire protection systems are custom engineered by Rockwood to meet the needs of every type of oil and gas installation. Send the coupon for details.



Double Strength FOAM Liquid Gives Double Protection. Three parts of Rockwood Double Strength FOAM liquid mixed with 97

parts of water and 900 parts of air form a firesmothering blanket that quickly reseals itself. You pay for only three parts per thousand for this ex-tinguishing agent that has proved its ability to put

out spill fires in flammable liquids, with maximum speed and safety for personnel. Tested and listed by Underwriters' Laboratories, Inc. Branch Offices

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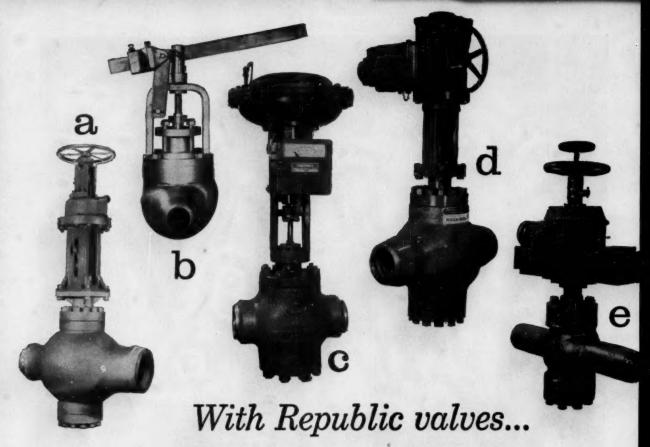
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CHEMICAL ENGINEERING-July 25, 1960



You get longer life, less maintenance

For over 35 years Republic valve developments have paced the changing demands for more sturdy valves by the most progressive utilities and industries. For such services as pump recirculation control, feedwater regulation, steam pressure reducing and high pressure water control, Republic valves have established a reputation for durability, long life and trouble-free performance.

Superior valve design-Republic research into the causes of valve noise and vibration, and also the wear resisting and galling properties of materials has resulted in a modern line of Republic valves of advanced design. Republic valve contours are designed to produce not only the desired regulating characteristics but also to reduce erosion damage and noise as well. Extra large guide bushings, extra deep stuffing boxes, solid plug inner valve construction, plus precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance.

Wide selection of valves and features—Rockwell-built Republic regulating valves shown on this page are representative of the complete Republic line:

- a. Cylinder operated valve
- b. Lever operated valve
- C. Diaphragm operated valve
- d. Motor operated valve
- e. Toggle head operated valve
- f. Diaphragm operated angle valve

And, for many special applications, such Republic accessories as pneumatic and electric valve positioners for hysteresis-free control, and a complete line of controllers are available.

Whatever your regulating valve problem, let Republic engineers put their years of application experience to work for you. For additional information, see your Republic representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois.

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CALENDAR

Massachusetts Institute of Technology, Dynamics and Control of Chemical Engineering Processes.

July 18-29 Cambridge, Mass.

Gordon Research Conference, Separation and Purification, Colby Junior College.
July 25-29 New London, N. H.

Gordon Research Conference, Instrumentation, Colby Junior College. Aug. 1-5 New London, N. H.

University of California, Gas Chromatography. Aug. 2-5 Los Angeles, Calif.

Gordon Research Conference, Organic Coatings, New Hampton School.

Aug. 8-12 New Hampton, N. H.

Technical Assn. of the Pulp and Paper Industry, 9th Pulp and Paper Statistics Course, Brevard College. Aug. 8-19 Brevard, N. C.

American Institute of Chemical Engineers & American Society of Mechanical Engineers, National Heat Transfer Conference and Exhibit, Statler Hotel. Aug. 14-17 Buffalo, N. Y.

American Society of Mechanical Engineers, Heat Transistor Division Conference, Statler-Hilton Hotel. Aug. 15-17 Buffalo, N. Y.

National Bureau of Standards, Cryogenic Engineers Conference.

Aug. 17-19 Boulder, Col.

Technical Association of the Pulp and Paper Industry, 14th Alkaline Pulping Conference, Multnomah Hotel. Aug. 22-24 Portland, Ore.

University of Colorado, 1960 Cryogenic Engineering Conference. Aug. 23-25 Boulder, Col.

Association For Computing Machinery, National Meeting, Marquette University. Aug. 23-25 Milwaukee, Wisc.

Technical Association of The Pulp and Paper Industry, Forest Biology Conference. Aug. 24-27 Seattle, Wash.

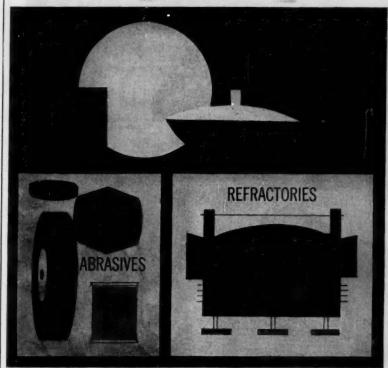
The Combustion Institute, 8th International Symposium, California Institute of Technology, Aug. 28-Sept. 2 Pasadena, Calif.

Public Health Service, Water Quality Measurement and Instrumentation Symposium, Sanitary Engineering Center.

Aug. 29-31 Cincinnati, Ohio

Air Force Office of Scientific Research, 8th International Combustion Symposium. Aug. 29-Sept. 2 Los Angeles, Calif.

Chemical Institute of Canada, Nuclear and Radio-Chemistry Symposium, Chalk River Laboratories. Sept. 6-8 Chalk River, Ontario



A FULL LINE OF HIGH-PURITY CALCINED ALUMINAS

Kaiser Chemicals now offers you two grades of calcined alumina—KC-1 and KC-2—for manufacture of high-grade abrasives, refractories and ceramic products. These are high-purity, uniform quality aluminas, both grades available in coarse and fine particle sizes.

And for manufacture of electrical and electronic grade ceramics that require superior dielectric properties over a wide temperature range, Kaiser Chemicals offers grades KC-10 and KC-14. These are high-purity aluminas produced with very low soda content.

Typical	CI	ien	ica	1 1	inal	yse	s:	KC-1	KC-2	KC-10	KC-14
SiO2 .							.	0.02%	0.02%	0.10%	0.10%
Fe ₂ O ₃								0.02	0.02	0.02	0.02
TiO2 .							. 1	0.002	0.002	0.002	0.002
Na ₂ 0							.	0.60	0.50	0.10	0.04
Loss on	ig	niti	on				.	0.70	0.10	0.15	0.15
AloOn (DV C	liff	erei	nce).		. 1	98.65	99.36	99.50	99.60

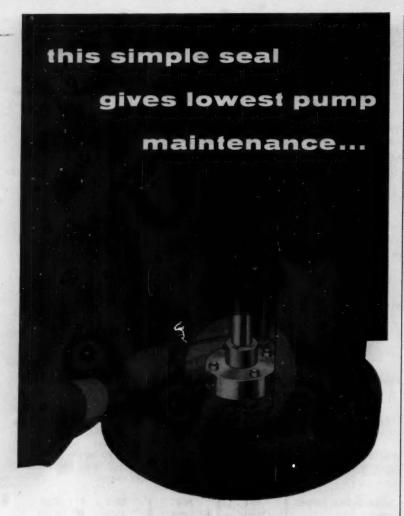
This wide range of top grade aluminas is designed to meet your specific performance requirements. For prompt service, or for specifications on any alumina product, call or write Kaiser Refractories and Chemicals Division, Kaiser Aluminum & Chemical Sales, Inc., at any of the Division Offices listed.

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Save up to 66% of the time-expensive downtimeneeded for installation or service of other mechanical seals used in plant process equipment.

The simple, effective Borg-Warner Type U Seal has no set screws-no close spring tension adjustments. It's fast and reliable.

For plants with a wide variety of pump service requirements, a minimum inventory of parts, and an easy change of gaskets adapts the Type U seal for service at temperatures of from -100 below zero to +650°F, and for pressures from 0 to 1000 psi.



Backed by Borg-Warner and proved in service, these dependable seals give complete safety, even in unattended stations.

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NEW EQUIPMENT . . .

(Continued from page 88)

lain bodies. If porcelain should break, armoring is said to hold the body together until lines can be repaired.

Spring arrangement on valve stem prevents plug from loosening under vibration and also absorbs hand-wheel tension after porcelain-to-porcelain seal is made, which warns operator that the plug is tight and locked with seat. Stem packing is Teflon.

Available in 1- to 6-in, sizes. valve is rated to 400 F. Top-size valves hold 50 psig., smaller ones are good to 100 psi.-Lapp Insulator Co., LeRoy, N. Y. 88U



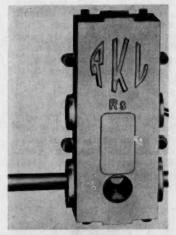
Valve Positioner

Fast, accurate action for electropneumatic device.

Electropneumatic valve positioner combines advantages of electronic controllers and pneumatic control valves, according to manufacturer. Device directly compares valve stem position with controller output signal to achieve dynamic response and positioning ac-curacy claimed unattainable transducer - pneumatic positioner combination.

Unit uses large, stabilized magnetic-force motor for highforce changes and high-capacity air relay for fast stroking speed. Relay may be mounted in any of four positions to facilitate piping. Stroke adjustment of positioner is made through plate opening without exposing any wiring. Standard stroke ranges are from # to 3

in. and from 2 to 4 in. Valve spring range is 3-15 or 6-30 psi. — Mason-Neilan, Norwood, Mass. 164A



Solenoid Valve

Permits straight-through flow in either direction.

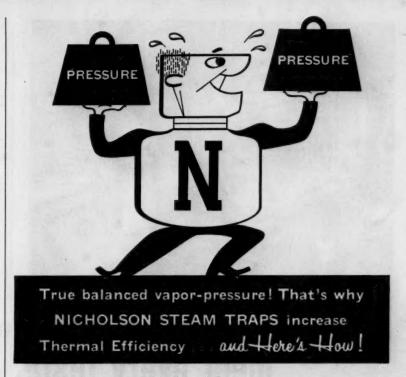
Solenoid-operated pinch-type valve for applications involving corrosive fluids, slurries, and dry powders gives gas-tight shutoff under vacuum or pressure conditions. Valve consists of a rubber body that is pinched closed by spring-loaded solenoid mechanism.

Normally closed, energized to open, valve operates on standard 110-v. power. Valve bodies of pure gum rubber hold pressure to 50 psi. at up to 180 F. Synthetic valve bodies are available in a variety of formulations. Outer cast-aluminum housing can be epoxy-coated for corrosive-atmosphere applications. Valve sizes: ½- to 1-in.—RKL Controls, Inc., Hainesport, N. J.

Vacuum Pump

Higher speed and throughput claimed for new units.

PMC line of high-speed vacuum-diffusion pumps now includes 2- and 10-in. models. PMC pumps are claimed by manufacturer to maintain peak





When live steam contacts the bellows of a Nicholson Trap, the pressure inside the bellows equals the pressure outside. With both pressures balanced, the spring

action of the bellows closes the trap. When condensate collects around the bellows, pressure inside drops causing outside pressure to compress the bellows and open the trap.

Briefly, this is true balanced pressure and is the operating principle of Nicholson Thermostatic Steam Traps. That's why they discharge condensate and air quickly, positively and intermittently... and why they help you get full thermal value from every pound of steam and full productive value from your steam equipment. They provide greater capacity, too...up to six times that of ordinary traps. And there's no steam waste either, because seats and

valves are of hardened stainless steel, finely ground and accurately lapped for sure, tight shut-off.

As for maintenance, it's practically nil... and here's why. In this simply designed trap there is only one moving part. No links, pins, pivots or levers to go wrong. No adjustable orifices to stick, wear or become clogged. No need for valve and seat changing. In short, no downtime because of trap failure.

Naturally, plus efficiency like this does not come at "bargain" prices. You can get cheap traps, of course. But remember this: price only shows up on the dealer's shelf; value is what shows up on your lines . . . and with Nicholson Traps it shows up in discharge action you can rely on to keep temperatures high and even for full thermal efficiency at point of steam use . . . efficiency that can often increase production as much as 20%.

This is low trap cost, where it really counts. Let's tell you more.

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Two Cleaver-Brooks 150-hp boilers satisfy all demands for steam at Shell Chemical Corporation's Union, New Jersey Technical Service Laboratories

"We find Cleaver-Brooks boilers meet every test we have given them for top operating performance," reports George Baranchulk, utilities and service engineer at Shell's research building. Mr. Baranchulk goes on to say, "There is extreme versatility to our load as our requirements for heating and experimentation may run as low as 10 hp in the summer to over 140 hp in the winter. Checks we have made of CO₂ and stack temperatures indi-

cate we are getting excellent operating efficiency — even when we vary the load over widely separated peak and low demands. These boilers have definitely lived up to every claim you have made for them."

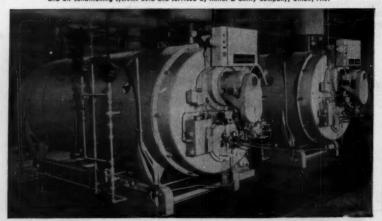
Put Cleaver-Brooks packaged boilers to the test! They are available in size from 15 to 600 km.

Put Cleaver-Brooks packaged boilers to the test! They are available in sizes from 15 to 600 hp . . . for oil, for gas or for oil/gas combination firing. Contact your representative or write Cleaver-Brooks Company, Dept. H, 345 E. Keefe Ave., Milwaukee 12, Wisconsin.



ORIGINATORS AND LARGEST PRODUCER OF PACKAGED BOILERS

TESTING — Fully modulated Cleaver-Brooks boilers burning No. 6 oil supply steam for heating presses, constant temperature rooms, laboratory uses, laminating plastics and air conditioning system. Sold and serviced by Miller & Chitty Company, Union, N.J.



NEW EQUIPMENT . . .

speeds up to 140% higher, over longer pressure ranges, than speeds attained with conventional high vacuum pumps of comparable size.

High speed and throughput are due to a new immersion heater in the boiler reservoir which speeds oil vaporization by direct contact with the pump fluid. Pump casing design minimizes vapor backstreaming.

The 2-in. model pumps 105 l./sec. over pressure range of 9x10-8 to 3x10-8 mm. Hg. The 10-in. pump handles 4,100 l./sec. from 5x10-8 to 1.5x10-8. Throughput cost is said to be about half that of conventional pumps.—Consolidated Vacuum Corp., Rochester, N. Y. 165B



Diaphragm Valve

Traps impurities on seat and still closes tight.

No filter is needed with new packless diaphragm valve which closes completely even when dirt particles are trapped on the valve seat. Resilient diaphragm withstands deformation by trapped particles, too, since after a prolonged shut-off period the diaphragm will resume its original configuration after the particles are washed away.

Rated for 500 psi., valve will close with only 10 in.-lb. torque in dead-end service for that pressure. Available in ½- or ½-in. sizes, units have neoprene, Viton A, buna, and other rubber formulations for diaphragm service. Knurled knob actuators

custom tailoring costs less than "ready-to-wear"

Buying an electric motor with "ready-made" insulation can be a costly luxury.

Motor operating conditions vary so widely throughout industry that Fairbanks-Morse insulation systems are *tailored* to actual operating conditions...not *standardized* to "the average".

"Ready-made" insulation systems are an "across-the-board" compromise with average operating conditions. When your case is the all-too-frequent exception, the compromise is costly.

Even in "hard to fit" cases we build motors rated, dimensioned and insulated to furnish unfailing power. Insulating materials are carefully tested, selected, treated and prepared so that insulation as well as motor enclosure is matched to the job. Entire insulation system is custom tailored to meet emergency overloads, temperature extremes, corrosive atmospheric conditions . . . whatever combination of factors affects motor life and performance of your specific operation.

This *flexible* application of varied insulating materials and processes "pays off" in low maintenance, uninterrupted production, prolonged service.



Whatever your motor needs . . . 1 hp or 10,000 hp . . . open or weather-protected . . . vertical or horizontal . . . synchronous or induction . . . AC or DC . . . Fairbanks-Morse builds it, builds it right, builds it to last. Get the facts . . . drop a line today to: Fairbanks, Morse & Co., Freeport, Illinois.

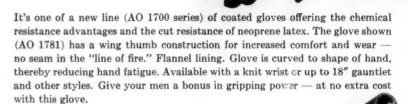
Fairbanks, Morse

ELECTRICAL DIVISION

A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION

Give your men an extra grip on the job.

Here's a neoprene glove that permits such a non-slip grip you'd think it had chains over its tread. Try it out gripping oily pipe, and you'll see what we mean!



- Superb Wet Grip
- Better Cut Resistance
- · Better Oil Resistance
- . Better Solvent Resistance

Note:

American Optical offers seven other lines of plastic coated gloves for chemical applications — also a line of "Saf-T-Glo" blaze orange gloves for high visibility and safety on the job. Your nearest AO Safety Products Representative can supply you.

Always insist on Trademarked Safety Products.

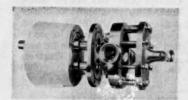
American Optical

SAFETY PRODUCTS DIVISION
Southbridge, Massachusetts

Safety Service Centers in Principal Cities

Your Surest Protection ... AO SURE-GUARD Gloves

are optional for automatic operation.—Geo. W. Dahl Co., Inc., Bristol, R. I. 166A



Gear Pump

Internal design said to improve pump efficiency.

New high-pressure gear pump has patented Teflon solid lubricant rings in the gears to center them in the pump housing. Continuous centering means minimum liquid slip, thus high pumping efficiency. Slippery Teflon also gives low-friction seal.

Maximum wear points are chrome-plated for long life, in the gear housing where Teflon rings ride and on the shaft under quad ring seals which are always in compression on the shaft. Shaft and gears are splined for rigidity, but gears slide off shaft for cleaning.

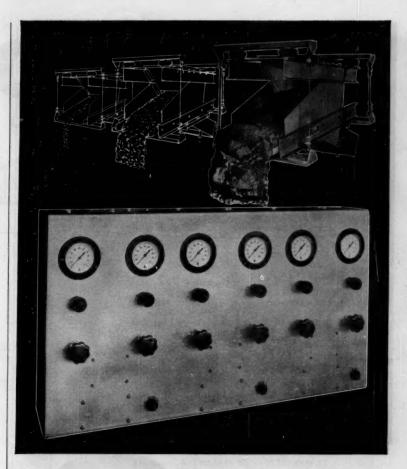
Pump comes in two sizes covering 1 to 30 gpm. at up to 400 psi. Safe operating temperature: up to 180 F.—Sonic Eng. Co., Stamford, Conn. 169A

Engine Control System

Automatically starts and stops gas and diesel units.

Automatic controls can now start or stop internal combustion engines in specific steps as required by the installation. System uses pneumatically actuated controls, can shut down the engine if any one of an unlimited number of variables gets out of hand.

All start and stop functions are interlocked, hence each succeeding step in the sequence is activated only if previous steps are operating all right. Variables of temperature, pressure, liquid level, vibration and en-



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With Carrier Amplitrol Feeders you can control discharge rates from ANY distance. Carrier Feeders give you precise manual OR automatic control in response to signals from bin-level indicators, process-alarms, scales, load cells, ball mill or crusher drives.

Speed and Accuracy Combined Three separate Amplitrol Feeders are controlled simultaneously with the control panel shown above. Used in a batch weighing system, the controls produce a fully adjustable high-low feed rate cycle for each feeder. For maximum batching speed with minimum batch variation, Amplitrol feeds the major portion of a batch at torrent rates—the remainder at a dribble. Shutoff at proper weight and recycling is automatic.

For more information, write Carrier Conveyor Division, CHAIN Belt Company, 214 North Jackson St., Louisville 2, Ky.

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this is the ideal valve for high-speed pumps

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bility. That's why DURABLA is the only valve ideally suited to highspeed operation.

DURABLA valve units operate freely under temperature-pressure extremes, with corrosive fluids and in any position. Available in 17 sizes, they will meet over 300 variations in installation requirements.

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*Patent applied for



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NEW EQUIPMENT . . .

gine speed are monitored continuously.

Operator can start sequence by pushing one button, at control panel or remote station. Control panel has annunciators hooked up to each step in the sequence. If shutdown occurs, operator checks annunciators to find where sequence was broken.

— Robertshaw-Fulton Controls Co., Knoxville, Tenn. 169B

BRIEFS

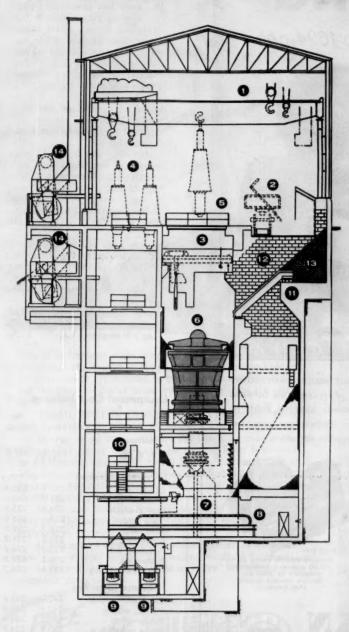
Electrical receptacle for hazardous locations has dead end contact feature which confines all arcing within the plug chamber. Units, which accept two explosion-proof plugs, are Underwriters' approved for Class I, Groups C and D hazardous locations.—

Appleton Electric Co., Chicago, Ill.

Relief valve and pressure regulator has adjustable pressure range from 0-3,500 psi., controls pressure within 2-3 psi. over entire adjustable range. Smaller units have 0-1,000 and 0-2,000 psi. ranges. Come in 1-, 1-in. sizes.—Atlas Valve Co., Newark, N. J. 170B

Bin level-indicator has flexible shaft by which 1/100 hp. motor turns 4-blade paddle. When material in bin reaches preset level, it stops paddle. Flexible shaft continues to turn until tension actuates limit switch which turns off motor and any other equipment controlled by unit. When material drops away from paddle, shaft unwinds, releasing switch, starting motor, and putting unit back in operation.-Compass Re-Pittssearch Associates, burgh, Pa. 170C

Variable speed transmission is now possible automatically or remotely with new air control. Speed is set by manual air valve or by signal generated by pneumatic transducer. Air signals from 3 to 15 psi. produce linear speed



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- 6. 60-in. Traylor gyratory primary crusher
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- 9. Two 54-in. chain-belt conveyors
- 10. Electrical control panel
- 11. 8-in. grizzly 12. 2-in. plate liners
- 13. Dead-bed areas

14. Air filter dust removal unit

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E.Z. Clean Cartridge liquid end simplifies maintenance. Simplex models pump up to 812 gph at a maximum pressure of 10,000 psi. Duplex models double that capacity.

American controlled capacity proportioning pumps have repetitive metering accuracy of plus or minus 1%, when operating between 10% and 100% of capacity. Feed precisely metered fluids or slurries in virtually all ratios, with flow, temperature, pressure, conductivity, pH and other controlled process variables.

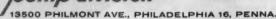
- · Interchangeable liquid ends
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- crossheads of hardened and ground steel ride on cast iron
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- NEMA frame motors
- · heavy duty reducers



Simplex models pump up to 13.10 gph at a maximum pressure of 1000 psi. Duplex models double that capacity.

AMERICAN METER COMPANY

pump division



NEW EQUIPMENT . . .

variation. — Graham Transmissions, Inc., Menomonee Falls, Wis. 170D

Air sampler weighs less than 4 lb., uses low-pressure lique-fied gas as vapor source for aspirator nozzle. Unit takes continuous sample of air for 90 min., checks it for seven different toxic gases.—Union Industrial Equipment Corp., Port Chester, N. Y. 172A

Conductivity monitor continuously indicates electrolytic conductivity measurement. Transistorized unit, with automatic or manual temperature compensation and continuous alarm signal, has output d.c. signal for transmission to recorder.—Leeds & Northrup Co., Philadelphia, Pa. 172B

Vacuum gage covers the range of 10-200 mm. Hg absolute. Claimed as first electrical gage in this pressure range, it gives direct readings independent of atmospheric pressure. SP-3 gage uses 90-135 v., a.c. — Hastings-Raydist, Inc., Hampton, Va. 172C

Equipment Cost Indexes . . .

Dec.	Mar.
1959	1960
237.0	237.8
231.1	232.4
239.0	240.0
224.6	225.8
225.6	226.6
228.7	229.7
230.2	231.3
233.6	234.7
236.5	237.5
235.4	236.3
242.1	242.8
240.4	241.5
267.3	268.4
223.9	224.9
	1959 237.0 231.1 239.0 224.6 225.6 228.7 230.2 233.6 236.5 235.4 242.1 240.4 267.3

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.



Patent Pending

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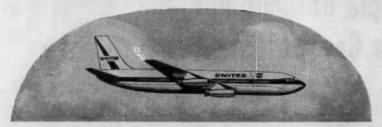


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TECHNICAL

Emphasis on Application

PROCESS ENGINEERING CALCULATIONS: Material and Energy Balances. By Mack Tyner. The Ronald Press Co., New York. 403 p. \$8.50.

Reviewed by Bernard S. Pressburg, Louisiana State University, Baton Rouge, La.

Unique features of this well planned book distinguish it from others devoted to the techniques and principles of making material and energy balances.

The book is logically organized and clearly presented, but the outstanding difference from other texts on calculations is the emphasis on application. While it has several chapters devoted to basic concepts of units, gas laws, phase relations, etc., these are very brief. Most of the book is concerned with their use: separate chapters, for example, demonstrate the common principles involved in applying material balances to unit operations and to unit processes, and energy balances to chemical processes and to the combustion of fuels.

Tyner's chapter on nuclear fuels introduces the principles and terminology that are unique to this subject and shows that the conventional principles apply. Likewise, his chapter on mathematical analysis of differential operations is timely in view of the trend toward treatment of process dynamics.

As a text for the students' first course in chemical engineering, which Dr. Tyner states is its purpose, "Process Engineering Calculations" has one objectionable characteristic: while comprehension of the over-all problem is desirable, the average beginning student may tend to lose sight of the fundamentals when they are mixed in with the description of the problem. The author minimizes this by good

BOOKSHELF

organization: each chapter has an introductory section which states what it demonstrates. Numerous problems of all degree of complexity force the student to recognize the basic concepts and to combine them in the solution of problems.

All students who completely master this book will be well prepared for subsequent courses. And, the reviewer feels, the inexperienced engineer in industry can profit by observing the comprehensive picture, as well as the details of the major topics mentioned here.

MORE NEW BOOKS

CHEMICAL INSTRUMENTATION. By H. A. Strobel. Addison-Wesley. \$9.75.

THE STORY OF ENGINEERING. By J. K. Finch. Doubleday. \$1.45.

PROFESSIONAL ENGINEER'S EXAMI-NATION QUESTIONS AND AN-SWERS. 2nd ed. By W. S. La Londe, Jr. McGraw-Hill. \$7.50.

PRESSURE VESSEL AND PIPING DE-SIGN. American Society of Mechanical Engineers. \$10.

MEDICINAL CHEMISTRY. 2nd ed. Ed. by A. Burger. Interscience. \$37.50.

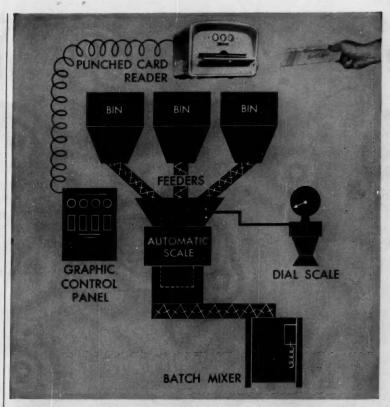
ADVANCES IN FLUORINE CHEMISTRY. Vol. I. Ed. by M. Stacey, J. C. Tatlow & A. G. Sharpe. Academic Press. \$8.

BERYLLIUM. By G. E. Darwin & J. H. Buddary. Academic Press. \$13.50.

Infrared Radiation. By H. L. Hackforth. McGraw-Hill. \$10.

ORGANOSILICON COMPOUNDS. By C. Eaborn. Academic Press. \$15.

Physical Methods in Chemical Analysis. Vol. I. 2nd ed. Ed. by W. G. Berl. Academic Press. \$19.



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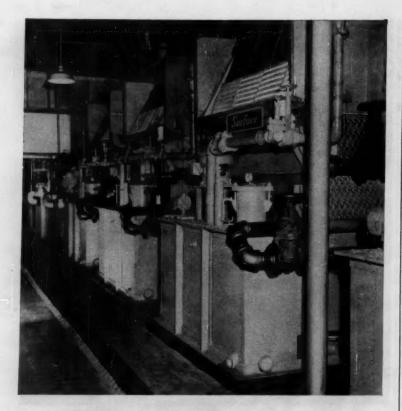
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CHEMICAL ENGINEERING—July 25, 1960



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LETTERS: PRO & CON

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DILUTE hydrochloric can be concentrated by this dual-pressure process.

Uses the Same Principle

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Sir

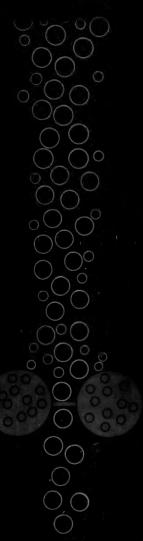
Your article on concentrating nitric acid by distillation at two pressures (Apr. 18, p. 94) was of considerable interest to me.

The same principle was applied to concentrating hydrochloric acid several years ago in connection with some research

on manganese ores. This work was published in Bureau of Mines Report of Investigations 5281, "Development of a Chloride Volatilization Process for Manganese Ores from Aroostook County, Maine," by R. T. Mac-Millan and T. L. Turner.

R. T. MACMILLAN

Bureau of Mines Washington, D. C.



Major refiners report.

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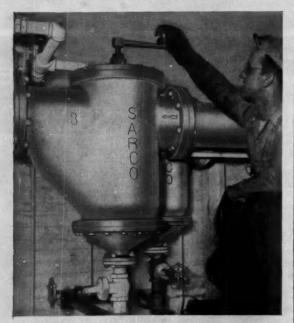
LINDE COMPANY

UNION

SARCO TOPICS

How correct strainer selection protects equipment, maintains fluid flow, and prevents shut-downs

Strainers for wash water for power plant condensers cleaned without shut down



Sarco Type VRS Rotary Scraper Strainers enable operators to clear the screens with a few turns of the crank, without shutting down the line or dismantling the strainer.

Sizable quantities of water are required for cleaning condenser water screens at a power plant in California. Sea water is pumped for the purpose and must be freed from debris and sea life such as mussels and sardines. Further, any screening devices used must be capable of cleaning without shut-down.

These problems were met by installing two Sarco type VRS scraper strainers ahead of the wash water pumps. This type of strainer is cleaned by rotating a spiral blade either manually or by motor drive. Motoroperated rotary-type strainers make it possible to clean the strainer continuously. The blade scrapes the screen clear, and collected solids are blown down from the strainer

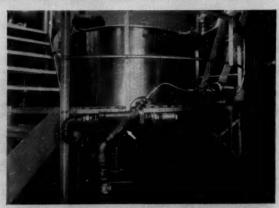
as required. Clean screens minimize pressure drop. The Sarco strainer installation has materially reduced maintenance hours and insured against temporary shutdown caused by clogged strainers.

Helical scraper knife clears screen without shutdown in East Chicago Air Conditioning System

Offices of the Inland Steel Company, at East Chicago, Indiana, are cooled with air conditioning units of 7½ tons and larger. Water for condenser cooling is pumped in from Lake Michigan.

Although passing through traveling screens, the incoming water still contained fine sand which clogged the screens. Frequent cleaning was required, and every now and again the units were practically out of service.

Plant engineers found their answer in Sarco Rotary Scraper Strainers, Type VRS. These units incorporate a hand-operated helical scraper knife within the cylindrical strainer screen. These scrapers made it possible to keep the strainers clean simply by cranking the scraper a few turns at regular intervals. Sand scraped off the screen is blown clear and discharged at pressure through a manually operated valve to waste. Now it is not necessary either to dismantle the strainer or shut down the unit.



IN PROCESS APPLICATION This Sarco motor operated-Scraper Strainer, Type SRS, is used to strain chocolate syrup in a processing application, providing continuous flow of fluid without shut-down for maintenance.

For information on Sarco strainers, contact your Sarco sales representative, district office, or distributor; or write-



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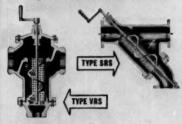
condensate, steam, water, oil, and other piped fluids

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PRO & CON . .

Swirl-Flow Set Straight

Your Chementator item in the May 16 issue (p. 71) concerning our swirl-flow heat-transfer research is erroneous in several important respects.

The swirl-flow principle, as far as we know, is not "in for its first commercial tryout." Initially, at any rate, it will not be applied to the high-flux isotope reactor. This reactor, incidentally, is scheduled to be in operation in 1964, not 1962.

The experimental equipment used was not "full-scale" with respect to any reactor except a very small one, such as the HFIR: the longest heated length we used was 17.4 in. Your persistent use of the word "exchanger" in place of the proper term "reactor core" should be

apparent to all.

We might be considered "pioneers of the swirl-flow concept" only as it applies to increasing the burnout heat flux, since some studies with nonboiling fluids were conducted at an earlier date than were ours. It should also be noted that R. D. Bundy and R. W. Wansbrough worked with me in development of the twisted-tape swirl-flow data; N. D. Greene, who took part in the earlier studies with inlet vortex generators, is no longer here.

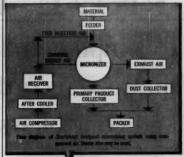
It should be made clear that the results shown in your illustration were obtained with a specific tape-twist ratio-namely, 2.08 diameters per 180-deg. twist. Furthermore, it should be stated that the power density of 570 mw./cu. ft. mentioned in your article corresponds to an average heat flux (from both surfaces of the tubular elements) of 9.0 × 10° Btu./(hr.) (sq. ft.); to our knowledge, it bears no relation to any reactor under serious consideration. Even conceptual designs for advanced units involve much smaller power den-

W. R. GAMBILL Oak Ridge National Laboratory Oak Ridge, Tenn.

▶ We apologize for the factual errors, the result of misinformation from another source. Some of Mr. Gambill's criticism, however, relates to our choice of terminology and the extent of detail warranted for a short news story .- ED.

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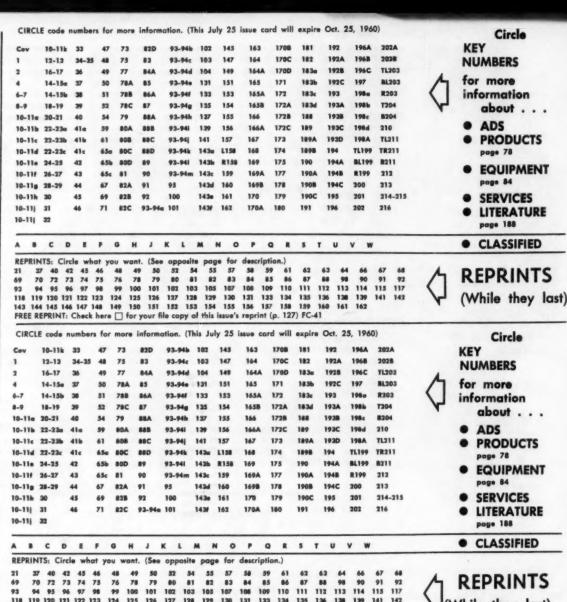
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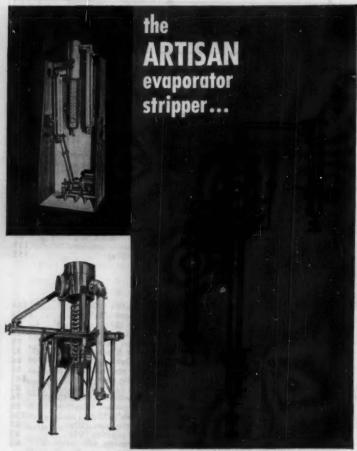
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Thermodynamic Princiles	(50€).									-						42
Compression & Expansion																	45
Chemical Equilibrium (5)																	49
Homogeneous Kinetics (50e)							 									57
Catalytic Kinetics (50¢).							*	 									61
Interpreting Kinetics (50)	e)							 	0		0						66
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Complex Reactor Design	(50¢).	*					*					×					75
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Contents of This Issue

Chemicals	188
Construction material	190
Electrical & mechanical.	192
Handling & packaging.	193
Heating & cooling	194
instruments & controls	196
Pipe, fitting, valves	197
Process Equipment	198
Pump, fans, compressors	201
Services & miscellaneous	202

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78 *Allied Chemical Corp

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Facts you should know about proper dampening of bimetal thermometers

It is generally assumed that bimetal dial thermometers are dampened merely to prevent pointer oscillation when used on vibrating equipment. True, the prevention of pointer oscillation is necessary, but there are more important reasons for the use of dampening. of dampening.

of dampening.

The primary reason is to preserve accurate calibration, especially in the lower temperature ranges where a thinner bimetal element is used. An undampened bimetal element, when subjected to shock or severe vibration, would have a tendency to unwind slightly and throw the instrument out of calibration.

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helping to maintain calibration accuracy.

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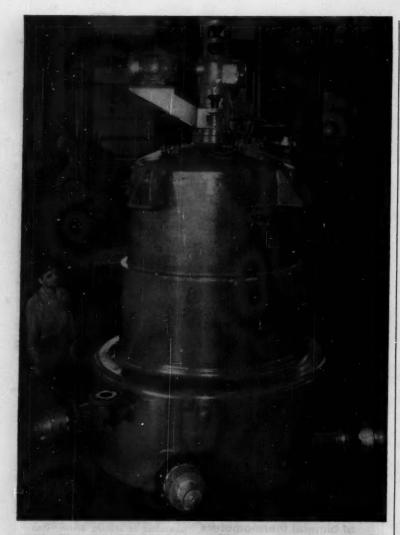
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190A Monsanto Chemical Co. Sulfur Trioxide...

Tritiated L-histidine new radio-active material for blochemical tracer studies, now available. Addi-tional information on request. No.

93-94h °U. S. Industrial Chemicals Co.

Vinyl Resin.....A 20-page illustrated booklet describes how vinyl disper-sions and film can affect product performance and add new dimen-sions to metal is available. 190B Monsanto Chem. Co.

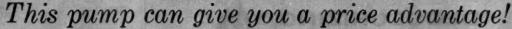
enium.....Data File contains all kinds of illustrations and covers production, milling, definitions, targets, corrosion, alloys, properties, fabrication, etc. 199C Carborundum Metals Co.

Construction Materials

Alloys..... Information about the properties and corrosion resistance of Hastelloy alloy F, contained in a 12-page booklet which is available on request.

4 Haynes Stellite Co.

^{*} From advertisement, this issue









Engineering Catalog.

GOSLIN-BIRMINGHAM

MANUFACTURING CO., INC. P. O. BOX 631 BIRMINGHAM, ALABAMA FILTERS . EVAPORATORS . PROCESS **EQUIPMENT • CONTRACT MANUFACTURING** including HEAVY CASTINGS

LITERATURE . . .

minum.....used in containers, handling and processing equipment for liquefied gases because of low-temperature properties. Informa-tion available. 18-19 "Reynolds Metals Company

Aluminum Electrical Rigid Conduit
.....needs no protective coating,
because it forms its own—an oxide
film that repairs itself when damaged. Full details.
24-25 "Rome Cable Div. of Alcoa

Aluminized Steel.....provides low-cost resistance to atmospheric cor-rosion. Complete information on the properties & applications of Aluminized Steel Type 2. 51 *Armco Steel Corp.

Ceating.....Kanigan applies a hard, corrosion-resistant nickel alloy coating. You can plate anything from a small relief valve to a 20,000 gal. tank car. Information. 133 *General American Transportation

Concrete Admixture.....for accelerating the hardening of mortor and concrete is the subject of a 12-page booklet describing the various uses. Sonneborn Chemical and Refng. Corp. 192A

Lead.....is one of the most efficient & economical protection materials against many acids. The Lead Handbook for the chemical process industries is offered. Bul. 162. 38 "American Smelting & Refining Co.

Protective Coatings.....Tygon Data
Book contains complete application
details plus helpful information on
performance of Tygon Paint over a
wide range of corrosives.
52 *U.S. Stoneware

Steel shelving.....36 pages list bolt-less T-line shelving, tool storage inserts, drawer case units, bin units, truck shelving, steel lockers and storage cabinets. 192B Alan Wood Steel Co. Penco Div.

re Cloth.....for your most diversi-fied bulk wire cloth needs. Thou-sands of items in stock in all meshes, wire sizes, metals or alloys. A 94-pg, catalog offered. "The Cambridge Wire Cloth Co.

Electrical & Mechanical

Air-Break Starter.....The complete story on certified fuseless fault pro-tection for high-voltage motor drives is contained in Bulletin 8130A. *Square D Company

tches.....Catalog describes line of magnetic particle clutches ranging in capacity from 2.5 ounce-inches to 1,900 pound-inches. Includes curves and installation drawings. 192C Lear Inc. Clutches . .

Electric Control Station.....meets requirements for operator convenience. Valve position indicator continuously indicates controller output when on automatic.

26-27 *Minneapolis-Honeywell

Gaskets.....can compensate for varying stresses and temperature changes...follow minor flange separation...and absorb vibration. Details in J-M catalog PK-35A.

33

^{*} From advertisement, this issue

LITERATURE . . .

Turbines.....four major advantages—easily transported, low cost installation, simple maintenance, low over-all cost. Informative brochures available.

44 *Solar Aircraft Co.

Gear-Driven Swivel Joints.....are available in 2, 2½, 3 and 4 inch sizes. Size & type to meet every requirement. Full catalog and price information.

61 *Continental-Emsco Co.

Mechanical Seals.....Type U seal for service at temperatures of from 100 below zero to + 650 F, and for pressures from 0 to 100 psi. Engi-nering information offered. 164 *Borg-Warner

Mechanical Seals.....provide perfect sealing—prevent loss of valuable fluids. For information on types of seals to meet your sealing needs, Catalog No. 480 CE. R158

Motodrives.....The AIRtrol is available on all Reeves motodrives. Examples of AIRtrol in process control systems is found in the Instrumentation Data Sheets.

50 *Reliance Elec. & Engr. Co.

or Mount......unequaled economies plus convenience. Motor can be mounted in almost any position around perimeter of reducer. Details in Bulletin 7100.

*The Falk Corp.

Motors..... Whatever your needs...1
hy or 10,000 hp...open or weatherprotected vertical or horizontal...
synchronous or induction...AC or
DC. Facts available.
167 *Fairbanks, Morse & Co.

cors....extra protected against corrosive or abrasive elements. Effective cooling system adds to motor life. Write for Bulletin MU-224 and MU-230.

42 *Wagner Electric Corporation

Motors and Generators....Condensed catalog describes 53 different drives, generators and motors and includes information on control units, and facts on motor application. 193A Electric Machinery Mfg. Co.

rmocouples.....with Ceramo con-struction are available in all standard calibrations, Over-all diameters 1/25" to -7/16". Bulletin 325-4.
T204 *Thermo Electric Co., Inc.

Thermocouple Accessories Just-released catalog gives data on thermocouple fittings, pressure sealing glands, wells, and tube assemblies. Conax Corporation

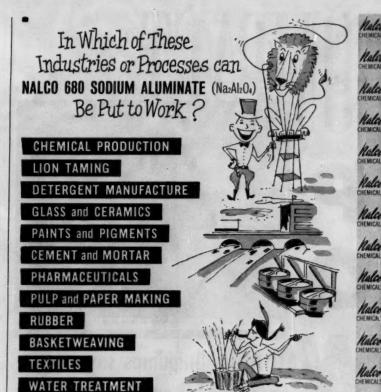
lists typical applications. Operating features and installation suggestions are accompanied by diagrams on power transmission.

193C Zero-Max Co.

Handling & Packaging

Conveyer.....Bulletin includes engineering standards and dimen-sions plus flow diagrams of repre-sentative systems. Photographs and drawings illustrate equipment. 193D The Fluidizer Co.

* From advertisement, this issue



As far as we know, only lion tamers and basketweavers don't use much Nalco 680 sodium aluminate. All the other industries listed do. So do many others. Nalco 680, a low-cost source of high purity alumina, offers many advantages as a chemical intermediate, including:

High alumina content—average 46% Al₂O₁.

Excellent stability-careful production processes, plus special stabilizers, maintain high stability while retaining an optimum Na₂O/Al₂O₃ molecular ratio of 1.15/1.

Purity—iron content is approximately .01 per cent; silicon, .02 per cent; and only trace levels of calcium, magnesium, and tin. Low corrosivity-Nalco 680 sodium aluminate solutions are alkaline, making stainless steel or rubber/plastic/lead lined equipment unnecessary. Also, when Nalco 680 is used with alum to produce alumina, NaOH from the sodium aluminate reduces alum-produced sulfuric acid.

Multiplicity of uses-Nalco 680 is a chemical intermediate of many uses. Some of the many compounds which can be made from 680 are: aluminum stearate, aluminum acetate, free alumina, acid alumina sols, aluminum hydroxide, paint gels, aluminum hydrates, and aluminosilicate zeolites.

Handling/shipping ease-Nalco 680 is easily and rapidly dissolved in water. Its high concentration means that less 680 is needed per process, saving warehouse space and reducing shipping expense.

The foregoing is only a brief description of the uses and advantages of Nalco 680 sodium aluminate. For complete information write for a copy of Nalco Bulletin K4. Or, call your local Nalco field representative.

Even if you weave baskets or tame lions, you may find a use for Nalco 680—
researchers are finding so many new uses for it that we'd be reluctant to say definitely that there's any industry or process in which it can't be used in some way.

NALCO CHEMICAL COMPANY

6236 West 66th Place

Chicago 38, Illinois

Subsidiaries in England, Italy, Mexico, Spain. Venezuela, and West Germany Germany In Canada—Alchem Limited, Burlington, Ontario

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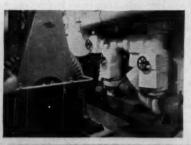


einman Unipumps save space, save weight, save costs

The Weinman Unipump in the photo above delivers 250 g.p.m. against a total dynamic head of 85'. Yet, as you can see, overall length doesn't exceed 261/4". Casing, normally cast iron, is also available in special alloys.

Efficient, compact Unipumps are available in capacities from 10 to 1700 g.p.m. Closed back design eliminates need for a second wearing ring or stuffing box water seal. They are probably the easiest-to-install pumps ever designed. You can mount them horizontally, vertically or at an angle and they will give long service at low maintenance cost.

You will want full performance and dimensional information about these versatile pumps. Call your Weinman pump specialist. He's in the Yellow Pages. Or, write us for Bulletin No. 300.



Two 3G25-2 Weinman Unipumps circulate brine in refrigerating plant for Rockefeller Center Skating Rink, New York City.

THE WEINMAN PUMP CO.

PRINTELLOAL SPECIALISTS

LITERATURE . . .

Belt Conveyors.....lowest cost and most dependable haulage. Unique design is self-propelled hopperfeeder that straddles the horizontal portion of inclined conveyor. 12-13 *Barber-Greene

Feeders.....Amplitrol Feeders can control discharge rates from any distance. Feed the major portion of a batch at torrent rates, the remainder at a dribble. Information. 169 "Carrier Conveyor Div., Chain Belt.

Hoists and Cranes.....Data on general features of all units and components, mountings, specifications, weights, dimensions, and lifting capacities given in 8-page folder.

194A American Chain & Cable Co.

Industrial Trucks Engineering bulletin IT-220 contains detailed information on and includes photographs and diagrams of gasoline, diesel and electric trucks.

194B Standard Oil Co.

Material Handling.....The Dempster-Dinasaur uses the inclined plane and hydraulics to achieve its fantastic load-lifting ability. Complete details in brochrue. 173 *Dempster Brothers, Inc.

Tractor Shevel.....will dig, carry and deliver more tonnage with lower operating and maintenance costs than anything near its size. Details on H-25 Payloader.

32 *Frank G. Hough Co.

Trucks, Industrial.....A package of 4 booklets tells how to find out the cost of owning and operating industrial trucks, including propane and electric powered ones.

194C Exide Industrial Division

Weighing System.....Select-O-Weigh governs all components required for automatic formulation by weight of a product, liquid or solid, involving any number of ingredients. 176 *Richardson Scale Co.

Heating & Cooling

Boilers, Packaged are available in sizes from 15 to 600 hp. . . for oil/gas combination firing. Complete information on boilers is available. 166 *Cleaver-Brooks

Dryers and Coolers.....lower per-ton drying and cooling costs with consistent uniformity of end product. Save floor space. Book 2511. 54 *Link-Belt Co.

Heat Exchangers.....Heat exchange equipment for virtually all conditions and applications. Full story on heat exchangers in Bulletin 0.4Ab.

47 *American-Standard

Heat Exchangers.....provides up to nine times the surface per square foot of shell-and-tube exchangers. Can handle as many as five fluids simultaneously.

28-29

*The Trane Co.

Heat Transfer.....Apply Platecoil to all types of tank and process heating and cooling. Several varieties available. More details available in Bulletin P61. 39 *Tranter Manufacturing, Inc.

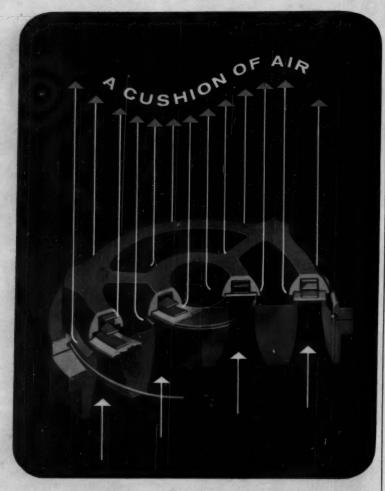
*From advertisement, this issue



Circuit judges of the pH court...recognized authorities in the field of electrometric measurement and control. Beckman pH meters have been rendering undisputed decisions for 25 years... ever since the first commercially available pH meter was developed by Dr. A.O. Beckman in 1935. Z Pictured at the left, the portable Model N-2 is the "circuit judge" of field determinations and arbiter of accuracy for permanent plant pH installations. At the right, Model N-1 is more likely to be found on the bench in laboratories and plant use everywhere. Z Both the N-1 and N-2 are easy to read, accurate to 0.1 pH, with reproducibility to 0.03 pH units. Less than 10 seconds warmup is required to provide readings over the full 0-14 pH range; 0 to ± 420 millivolts. Battery operated, they may be used with grounded systems, and are temperature compensated from 0 to 100°C. Both rugged models are supplied with a complete complement of basic electrodes and other essential equipment. In any case of pH analysis and control it's good judgment to get full technical details and specific application information from your Beckman laboratory apparatus dealer or field office. Or write to us for Data File 14-31-01. Beckman

> Scientific and Process | Instruments Division Beckman Instruments, Inc. 2500 Fullerton Road, Fullerton, Californi





makes PENNSYLVANIA COMPRESSORS run efficiently...silently...with minimum maintenance. Stainless steel valve discs lift against a cushion of air in the simple, efficient design of the Air Cushion Valve that makes PENNSYLVANIA Compressors run so silently, so dependably, and with such low maintenance requirements. Air Cushion Valves have no nuts, bolts, or screws to break or burn fast. You get longer valve life . . . eliminate wear , . . eliminate noise caused by metal striking metal. Flat valve discs have no flexing or bending action to weaken or distort them; they remain perfectly flat and tightly seated over long periods of service.

But this is only part of the PENNSYLVANIA story. Learn all the facts in "Compressors For Industry." It describes PENNSYLVANIA Compressors from 10 to 350 hp, horizontal, angle, and OILFRE models. Write to Dept. A-7 for your copy today.

PENNSYLVANIA PUMP AND COMPRESSOR COMPANY Eastin, Pa. • Earning Gustomer Confidence Since 1920







LITERATURE . . .

Panelcoil....offer fast, efficient heat transfer. Easier to install. New Technical Data Sheets Nos. 15-60 series and Price Bulletin 259. TR211 *Dean Products, Inc.

Steam Traps.....The 44-page book gives specific data on the selection & sizing of traps. Also information on design & construction of Inverted Bucket Steam Traps. 101 *Armstrong Machine Works

Steam Traps.....operate on a true balanced pressure principle....they have only one moving part. Offer positive shut-off, high capacity & rigid pretesting. Catalog 400. 165 W. H. Nicholson & Co.

Switches.....Subminiature switches are described in two folders, one appropriately named, "Thinking Small." Reprint from "Business Week" is also available.

196A Minneapolis-Honeywell Co.

Instruments & Controls

Analyzers, Boiling Point.....initial to 10% and below 90% to end point. All the technical facts on Shell Boiling Point Analyzers available on request.

147 *Hallikainen Instruments

Controller.....solve bothersome industrial problems such as simple batch polymerizations, dissolvers, rubber processing, etc. Better quality and uniformity. 83 The Foxboro Co.

Dial Thermometer.....Both vapor tension and gas-filled types are available in either distant reading or rigid stem types. Catalog offered. BL203 "Marsh Instrument Co.

Infrared Analyzer.....Substantially reduces size, complexity and high cost of most available instruments. Weight: 40 lbs. Bulletin 300.

34-35 *Mine Safety Appliances Co.

Lab Instruments.....A complete catalog of 60 pages covers descriptions and data on everything from ampots through polarographs to viscosimeter and water baths. 196B E. H. Sargent & Co.

Lamp Annunciators.....Bulletin describes system designed to indicate visually and audibly adnormal conditions; changes in pressure, temperature; equipment failure etc. 196C Edwards Co., Inc.

Mass Flowmeter......measures, in pounds, fluid streams over wide fluctuations in flow rate, density, pressure, temperature, and viscosity. More information available. 20-21 *General Electric Company

Meter.....Both model N-1 and N-2 are supplied with a complete complement of basic electrodes & other essential equipment. Tech. details in Data File 14-31-01.

195 *Beckman Instruments, Inc.

Thermometer, Dial.....are thoroughly dampened with silicone on the bimetal elements a special precision-machined bearing on the shaft. General Catalog.

189 *Rochester Mfg. Co., Inc.

^{*} From advertisement, this issue

LITERATURE . . .

Transmitter.....measures & transmits a linear signal of true flow which can be recorded on the same uniformly graduated scale or chart as pressure, temperature & level.

182 "Bailey Meter Co.

Pipe, Fittings, Valves

- e.....Both solid pipe and lined pipe to meet your piping needs. Booklet available on "The ABC's of Penton for Corrosion Resistance" which gives performance ratings. 14-15a *Hercules Powder Company Pipe.
- e......Complete information on current sources for Penton prod-ucts is listed in "The Penton Buy-er's Guide." Available upon request. Handy reference. 14-15b "Hercules Powder Company
- e.....Saran lined pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200 F. Information. 90 °Saran Lined Pipe Co.
- e PVC......won't corrode. Unaffected by most acids, alkalies,
 salt, alcohol and oil. Solutions carried remain pure. Does not react
 chemically. Booklet.

 1 *B. F. Goodrich
- Pipes, Piastic.....Bulletin CE-50 contains 20 valuable pages . . . comparable properties, chemical resistance, costs, etc. of 11 plastics & rubber materials.

 157 *American Hard Rubber Co.
- Tube Fttings.....Hi-Seal is available in steel, stainless, aluminum and brass for %" to 1\%" O.D. tubing. Further information in Catalog
- 3108. 99 °The Imperial Brass Mfg. Co.
- Valve.....units operate freely under temperature-pressure extremes, with corrosive fluids and in any position. Available in 17 sizes. Booklet CE 70 is offered. 170 *Durabla Mfg. Co.
- Valve, control.....available in globe or angle body single port construc-tion. For use on heavy duty appli-cations involving corrosive liquids. Information. 87 *Fisher Governor Co.
- ves..... Rotovalve units accurately control or shut off in high-temperature, high-pressure reactor applications. Detailed information is available. *Allis-Chalmers
- Valves.....gate valve of the flanged end type available in sizes from 2" to 24" in bronze trim or all-iron construction. Other valve lines available. 46 *American Chain & Cable Co., Inc.
- .Complete line includes all types of valves in bronze, iron, steel & corrosion resistant metals & alloys, for pressures from 125 to more than 2500 lbs. Details.

 77 *The Wm. Powell Company
- ves.....Wide selection of valves & features plus such accessories as pneumatic & electric valve positioners for hysteresis-free control & a complete line of controllers.

 162 *Republic Flow Meters Co.

* From advertisement, this issue

ONLY STEARNS INDOX V

ceramic magnet drum separators give you job-proved protection

CHECK THESE FEATURES BEFORE YOU BUY

- Uniform magnetic field strength regardless of drum width — means higher capacity ratings, size for size.
- Factory-sealed bearings prelubricated for life.
- All-stainless steel drum, hopper plate, division plece and leveling gate for maximium wear resistance.
- Optional spouting arrangements vertical or angular — mounts easily in any system.
- Fully enclosed, dust-protective housing readily modified for use in air pressure systems,
- Exclusive direct gear-motor drive — safer, eliminates belts, chains, sprockets and guards.



proved INDOX V drum separators is available to match your spout systems. Call your local Stearns representative for full details, or write for Bulletin No. 1051 C.

Stearns Magnetic — first in the field with ceramic magnet drum separators-offers you the advantages of the only successful field-proved design with the INDOX V permanent magnet drum separator.

Install a Stearns INDOX V permanent magnet drum separator and forget about tramp iron worries. The field-proved Stearns INDOX V ceramic magnets, with radial pole design, provide pow-erful fingers of magnetism that reach out into fast-flowing materials-stopping and shunting off harmful tramp iron that could wreck equipment and contaminate product material.

The Stearns INDOX V drum separator is ideal for process industries where materials are conveyed in enclosed chutes and

A complete line of Stearns job-

WHAT IS INDOX V?

INDOX V is a highly oriented barium ferrite ceramic material. Its energy is comparable, on an equivalent weight basis, to that of ALNICO V - the most powerful permanent magnet material available. INDOX V magnets possess unique advantages - light weight, high electrical resistivity, great resistance to demagnetization, inexpensive, non-critical raw materials plus an energy product over three times that of non-oriented ceramic magnets. INDOX V is used in magnetic separators manufactured by Stearns exclusively.



STEARNS MAGNETIC PRODUCTS

635 South 28th Street

Milwaukee 46, Wisconsin

Profit with Stearns — First with Ceramic Magnet Separators for Industry

GAULIN GTA

(Gaulin Technical Assistance)

Takes The Risk Out Of Performance ... Helps Cut Costs, Too.



GTA Bulletins





GAULIN GTA provides free technical data. experienced advice and laboratory evaluation. Assures the right equipment for the process . . . provides dollar savings.



Gaulin Homogenizers

and SUB-MICRON DISPERSERS reduce ingredients to finer, more uniform particle size.

Gaulin Homogenizers and Sub-Micron Dispersers disperse, emulsify and blend products reducing them to their ultimate particle size. They improve product uniformity, stop separation, assure more stable emulsions, accent taste, stop color separation. Ask for Bulletins - Homogenizers H-55; Sub-Micron Dispersers SMD-55.



Gaulin High Pressure Pumps

handle all types of liquids and densities of fluids . . . deliver measured flow in metering applications.

These rugged, heavy-duty pumps are built to minimize operating, inspection and maintenance costs. Capacities to 7500 GPH . . pressures to 12,000 PSI. Well area can be gasketed to provide maximum safety in handling hazardous materials. Write for Bulletin P-55.



World's largest manufacturer of stainless steel reciprocating, rotary, pressure exchange pumps, dispersers, homoge-nizers and colloid mills.



GAULIN RE COLLOID MILL

Two-stage design provides continuous micrometer control for producing superior emulsions or dispersions. Available on rental basis of only \$75.00 per month. Ask for Bulletin C-57.



LITERATURE . . .

Valves.....gate and globe available from stock in ¼" thru 2" sizes and in both socket weld and screw ends. New forged steel inside screw and bolted bonnet. *Henry Vogt Machine Co.

res, Ball.....Plastic ball valves feature quick ¼ turn shut-off, ad-justable seats, full flow character-istics, no sticking or scaling, etc. *Chemtrol

Valves Control.....Engineering, speci-fication and purchasing informa-tion on cast, barstock, and special valves available in sizes from ½" to 14" given in 16-page catalog. 198A General Kinetics Corp.

Valves, Lubricated Piug.....are available in rectangular, round, diamond & V ports; venturi, multiport & steam-lacketed models. Sizes ½" through 30". Catalog 400.

141 °W-K-M Div. of ACF Industries

Welding Fittings.....Fabricated sections can be installed without delays because each fitting is well within tolerance. Bulletin FB-502.

100 *The Babcock & Wilcox Co.

Process Equipment

Centrifuge.. The P-600 Super-Dcanter continuously handles a wide range of particle sizes in slurries with solids concentration from ½ to 50%. Bul. 1287. 65a The Sharples Corp.

Centrifuge......The Fletcher Pilot Plant Basket centrifuges routinely handle loads up to 80-100 lbs./cu. ft. densities, with variable speed drive from 800 to 3250 RPM. Bul. 65b *The Sharples Corp.

Centrifuge The Laboratory Super Centrifuge is available in either continuous or batch types, motor or turbine driven. Information in Bulletin 1269. *The Sharples Corp.

Chemical Processor.....provides unlimited service life due to 100% corrosion-resistance. Ryertex-Om-cron PVC resists 281 corrosive solutions and gases. *Ryerson Steel

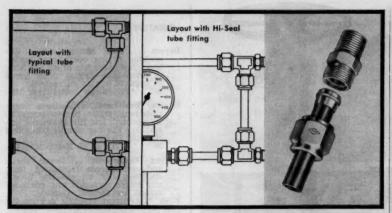
shers.....Complete information about the 60" gyratory crushers and other Traylor crushers made for primary, secondary or fine reduc-tions in Bulletin No. 1126. 171 "Traylor Engineering & Mfg. Crushers.

Drum Separators......The Indox V drum separator is ideal for process industries where materials are conveyed in enclosed chutes & sprouts. Details in Bulletin No. 1051 C. 197 *Stearns Magnetic Products.

er.....Molecu-Dryer models pro-vide optimum adsorption efficiency, and fast desorption & cooling. A comprehensive picture of Molecu-Dryer in Bulletin 5703. *C. I. Hayes, Inc.

er....The vertical, continuous Turbo Dryer is available both for indoor or outdoor use. Packaged units up to 360 sq. ft. net. Field units up to 18,000 sq. ft. net. TL203 **Wyssmont Co., Inc.

* From advertisement, this issue



How Hi-Seal saves space...cuts costs

These two sections of typical tubing layouts show how you save time and money using Imperial Hi-Seal butt-joint tube fittings in tubing circuits:

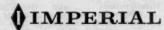
- 1. You save up to 50% on space requirements by making butt joints.
- 2. You use less tubing. Fewer bends are required.
- 3. You cut man-hours in installation. There's no danger of over-torqueing

a Hi-Seal fitting. You can see when a Hi-Seal joint is tight. When the threads are covered, the seal is pressure-tight beyond the strength of the tube itself.

Hi-Seal conforms to J.I.C. and A.S.M.E. standards . . . is available in steel, stainless, aluminum and brass for $\frac{1}{2}$ " to $\frac{1}{2}$ " O.D. tubing. Write for Catalog 3108 or call your Imperial industrial distributor.

THE IMPERIAL BRASS MFG. CO.
Department CME-70
6300 West Howard Street, Chicage 48, Illinois

27-60

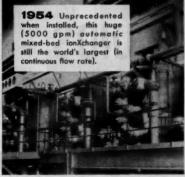




WORLD'S LARGEST MANUFACTURER OF VERTICAL HELICOID SCREW ELEVATORS

PATHWAYS OF A PIONEER DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR LOCAL COMMON COMMON





This power plant, where the big ion-Xchanger shown above is installed, furnishes steam for much of mid-town Manhattan.

Blazing New Paths in De-I Developments

IWT originated the Mixed-Bed De-Ionizer in 1949, and automatic versions of this high-performance equipment have been in use since 1953. The big one shown above delivers an unbelievable volume of water of "fantastic purity" (to quote the operators). For example, soluble silica in the feed water for the high-pressure boilers runs .01 ppm or less, and other impurities are unmeasurable. Such performance is in accordance with design specifications and proposal promises. Such successful pioneering has paid off handsomely for later purchasers of IWT equipment.

THIS EXPERIENCE

If you need pure water for high-pressure boiler make-up or process use, or if you are considering the use of ion-exchange for purification or concentration of chemical products, be sure to take advantage of IWT's 22 years of experience and vast array of specialized knowledge. Call your IWT representative.

ILLINOIS WATER TREATMENT CO.

840 CEDAR ST., ROCKFORD, ILLINOIS NEW YORK OFFICE, Itil E. 49th St., New York 17, N.Y. CANADIAN DIST., Pumps & Schemers, Ltd., London Ont.

HANDLING "PROBLEM" **FLUIDS** OR GASES?

Specify Aluminum Gate Valves by DARLING

Where you're handling highly corrosive materials ... or where valve weight is a factor... Darling Aluminum Gate Valves make sound economic sense.

High-corrosion-resistant aluminum alloys carefully selected and thoroughly tested by Darling metallurgical engineers, are used for structural and pressure-containing parts. They've been proved-in-use as the most generally corrosive-resistant aluminum alloys in use today.

Double disc parallel seat principle assures maximum life under the most exacting service conditions. "No pocket" discs and wedges prevent accumulation of line scale or sludge. Wedge design reduces friction to a minimum,

assures positive sealing and ease of operation.



Aluminum flanged end gate valve. Also available with other types of ends. Can be furnished with in-



DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont. LITERATURE . . .

ers.....Case history sheets de-scribing drying operations involv-ing a few cubic feet of air per hour or thousands—drying other gases or organic liquids on request. 201 *Pittsburgh Lectrodryer Div. Dryers.

Dryers, Desiccant.....features complete reactivation, perfect temperature control and full automatic operation. Further details contained Bulletin D-103.

36 *The C. M. Kemp Mfg. Co.

Drying Equipment.....Dryer shells and components fabricated from stainless steel an absolute neces-

sity where corrosion and contami-nation are factors. Catalog. B204 *Davenport Machine & Fdry Co.

Evaporator Stripper.....is particularly useful for recovery chlorinated hydrocarbons from relatively non-volatile contaminants with a high rate of solvent recovery.

188 *Artisan Metal Products, Inc.

Filter.....The D-C-D (dry cake discharge) filter permits dry cake removal without opening tank. Full details in the 4-page techenical bulletin which is offered.

R203 *Hercules Filter Corp.

ers.....that meet exacting filter problems particularly hazardous liquids. Recommendations offered. Manual and automatic operation available. *R. P. Adams Co., Inc.

Homogenizers and Sub-Micron Dispersers reduce ingredients to finer, more uniform particle size. They accent taste & stop color separation. Bulletins offered. 198a "Manton Gaulin Mfg. Co., Inc.

itles.....for chemical reaction con-centration, drying, crystallization, mixing, distillation, solvent re-covery. Further details in Catalog 356-R.

Kiins & Dryers.....Specially designed, directly fired or indirectly heated, rotary klins, dryers, roasters, ovens, calciners. Illustrated catalog shows unusual installations. 212 *Posey Iron Works Inc.

Laboratory Homogenizer....Minimum sample one pine; capacity 16 GPH; pressures up to 8000 PSI. Additional information is contained in Bulletin LH-55. 198e *Manton Gaulin Mfg. Co., Inc.

ronizers.....grind & classify in one operation in a single chamber & provide fines in range from ½ to 44 microns. Eight models are available. Description in Bul. 091. 181 *Sturtevant Mill Co.

Mil-Reacter....complete process unit, replacing separate reactor, blender, dryer, grinder, and solvent extrac-tor. Details available in Mil-Re-actor story.

43 Patterson Foundry & Machine Co.

I.....The two-stage design of the RE Colloid Mill provides continuous micrometer control for producing superior emulsions or dispersions. Bul. C-57. 198d Manton Gaulin Mfg. Co., Inc.

is.....compact grinding unit occu-pies small floor space, fits into plant layout. Catalog No. 87 available on "Mill of a Thousand Uses." 102 "Combustion Engineering, Inc.

* From advertisement, this issue

LITERATURE . . .

Mills, Hammer....feature extra heavy manganese steel liners & breaker plates, oversize shafts, massive parts & reinforcements. Catalog is available *Williams Patent Crusher

to 200 HP. Special units to 500 HP. Horizontal or vertical motor drive. Mechanical seal or packed stuffing box. Data in Cat. A-19.

*Philadelphia Gear Corp.

Pressure Filter....Vallez rotating leaf pressure filters were designed spe-cifically for removing color & puri-fying corn syrup. Information on this & other equipment. 192 "Goslin-Birmingham Mfg. Co.

Pressure Vessels.....fabrication of almost any type of pressure vessel or other heavy equipment used in the petroleum, chemical or other processing industries. Booklet.

40

*Newport News

eens.....special capacity advan-tages over standard wedge-wire screens because of high-narrow profile wires that provide larger open area. Catalog. 48 "National-Standard Co.

diners.....Information on all types of strainers including pipeline strainers, scraper strainers both hand operated & motorized, and self-cleaning Y-type. *Sarco Co., Inc. Strainers.

ing Pan Filter.....handles ma-terials that are too free-filtering for vacuum pick-up. Information on use and economics in new bulle-Tilting COVER .. *The Eimco Copration

Ventilators.....Vano Ventilators are portable & easily adaptable to practically any "fresh-air" require-ment in industry. Facts available. 31 "Coppus Engr. Co.

Pumps, Fans, Compressors

Compressor The RX compressor offers continuous compressor air power & requires only routine at-tention. Complete information on RX compressors in Bul. HAC-40. *Gardner-Denver Co.

.The axial flow rotary Compressor.... compressor offers capacities 100-12,000 cfm, pressures to 15 psig & cavuums to 22" Hg. Complete information. *Ingersoll-Rand

npressors.....Two-stage Ro-Flo built in 12 sizes to handle from 250 to 1800 cfm at pressures from 60 to 125 psig. Single-stage units up to 50 psig, from 40 to 3000 cfm. 139 *Allis-Chalmers Compressors.

Compressors.....Booklet entitled, "Compressors for Industry" describes compressors from 10 to 350 hp, horizontal, angle, and Oilfre models.

196 *Pennsylvania Pump & Compressor

.. No possibility Fans, Rubber-lined of separation, hardening or crack-ing. Whatever the type of severe service there is a fan to handle the job. *Buffalo Forge Co.



Sohio installs central Lectrodryer for plant's instrument air

The BWC-750 Lectrodryer shown above is serving the fluid catalytic cracking unit at Standard Oil Company (Ohio) in Lima. Replacing two smaller units, it delivers air at -100°F in a volume well ahead of maximum demand. Now there's no chance of instrument failure because of air-line freezeups, no rust or mud to clog instrument ports.

In refineries and other processing plants, small dryers have often been placed at outlying locations, near the operations they serve. This meant

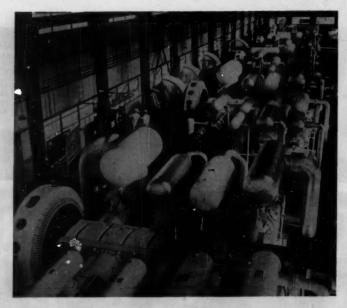
many dryers to service and the possibility of freezeups between the air compressor and dryers. Many of these smaller dryers are being replaced with single, large Lectrodryers, able to dry all the air a plant uses.

Case history sheets describing drying operations involving a few cubic feet of air per hour or thousands - drying other gases or organic liquids - will be sent at your request. Tell us your drying problem and we'll recommend drying methods and equipment. Write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd Street, Pittsburgh 30, Pa.





^{*} From advertisement, this issue



Petroleum Chemicals, Inc., Installs 98 **Burgess-Manning Snubbers To Prevent** Pulsation Damage In New Ammonia Plant

Foster Wheeler Corporation was contracted by Petroleum Chemicals, Inc., to design and construct a multimillion dollar ammonia process plant at Lake Charles.

Realizing that gas pulsation would cause severe operating problems in the multi-service process piping related to reciprocating compressors, and that hazardous pulsation should be engineered out of the plant in the initial design, Foster Wheeler called upon Burgess-Manning Company to develop pulsation snubbers for various service conditions and for installation under the original contract.

Ninety-eight pulsation snubbers of 46 individual designs were installed multi-stage, multi-service compressors. The snubbers were installed on both the suction and discharge sides of the compressor cylinders in what is believed to be the largest single installation of pulsation snubbers under

The compressors handle various types of gases, ranging in molecular weight from 5.13 to 33, at pressures from atmospheric to 9,270 P.S.I.A.; and at discharge temperatures to 350° F. Under these exacting conditions,

Burgess-Manning accepted the responsibility to engineer and supply pulsation snubbers of optimum design that would: 1. Hold the pulse amplitude to 2 per cent or less, total surge peakto-peak, of absolute line pressure, and 2. hold a minimum pressure drop requirement.

The snubbers were subjected to the stringent specifications of material, workmanship, and inspection procedures normally followed by Foster Wheeler in process plants of this type. All forged snubbers for high-pressure service were made of high tensile alloy steel. Internal assemblies were engineered to withstand extreme forces.

After the plant went on stream, operational inspection revealed minimum pulsation-induced vibration, eliminating operating hazards, constant maintenance, and upkeep of the laterals, headers, intercoolers, and separators attendant to the snubbers.

If you are planning a new plant, or have a pulsation problem in your present plant, it will pay you to consult Burgess-Manning -- "The Sound Engineering People." There's no obligation, of course.

LITERATURE . . .

Pump.....Full performance and di-mensional information about Uni-pumps is contained in Bulletin No. 300. Available in capacities from 10 to 1700 g.p.m. 194 *The Weinman Pump Mfg. Co.

Pump. Glassed.....won't contaminate your product. It exerts no catalytic effect. Products won't stick to it, causing shutdowns for cleaning. Details in Bul. 725.2. 191 *Goulds Pumps, Inc.

mps..... built specifically for pumping sulfuric acid solutions. Corrosion negligible at 80° C. for concentrations up to 65% and above 93%. Bulletin.

135 *The During C.

Pumps, Chemical Feed.....New 200
Series Simplex model can pump up
to 812 gph. Duplex model has
double this capacity. Maximum
pressure of 10,000 psi. Information.
172 "American Meter Co.

Pumps, High Pressure....handle all types of liquids and densities of fluids . . deliver measured flow in metering applications. Bulletin P-55 offered. 1986 *Manton Gaulin Mfg. Co., Inc.

Pumps, Progressing Cavity.....a 20-page catalog discloses the complete line of progressing cavity pumps and application data on possible uses of the pumps.
202A Moyno Pump Co.

Pumps Vacuum.....Bulletin includes specification charts, performance curves, descriptions and price and ordering information as well as five page vacuum theory article. 202B Precision Scientific Co.

Services & Miscellaneous

Fire-Fighting Products& Systems. FogFoam systems are custom engineered to meet the needs of every of oil and gas installation. type of Details. *Rockwood Sprinkler Co.

Impact Wrenches.....Information on 2 new, lightweight impact wrenches is available. Model 18B-9, 1½" capacity, Bul. 18-15. Model 18B-7, ¾" capacity, Bul. 18-11. 155 "Gardner-Denver Co.

Progressive Automation.....can help achieve plant flexibility, increased power efficiency, and accurate process control. Learn how to use existing facilities.

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Refractories ... withstand many gases, acids, salts and molten metals. Withstand temperatures of from 2800°F to over 3000°F. Special refractories bulletin. *Carborundum

Structures..... Hortonspheres are used extensively for the storage of volatile liquids & gases under pressure... with or without refrigeration. Full details.

81 *Chicago Bridge & Iron Co.



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Wire arms cut off the cake from the rotatable filter leaves and drop it into a V-shaped sump. It is then removed from the tank by means of a helicoid screw conveyor. The rotatable leaves may then be let cleaged, if desired.

H-Rim design of circular rotating filter leaves a lows for quick change of cloth or metal screens.

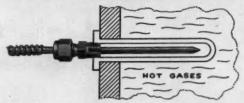
For full details, write for 4-page technical bulletin, "Hercules D-C-D Filters."

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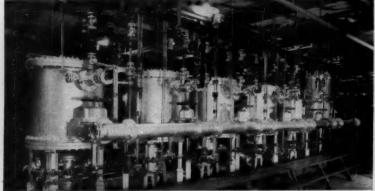
For measuring all types of process temperatures, T-E's "Ceramo" construction—ceramic insulation, metal sheathing—provides a tremendous increase in thermocouple life over conventional, openend types. In a typical application, enclosed hot junction, 1/2" O.D. "Ceramo" thermocouples were used recently in a hydro carbon cracking unit operating continuously at 1616° F. "Ceramo" thermocouples lasted 7 to 9 months—while 14 gage bare wire thermocouples lasted but 2 to 14 days. And there was no significant difference in response. "Ceramo" thermocouples are available in all standard calibrations. Overall diameters-1/25" to -7/16". Write for Bulletin 325-4

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Hazardous liquids are totally contained in Adams filters. All types of critical liquids alkaline solutions, mineral and organic acids, and hydrocarbons - are typical of the arkaine solutions, mineral and organic acids, and hydrocarbons—are typical of the services where human safety demands no contact between the operator and the product. Adams design permits filtration in a totally enclosed filter which is backwashed without disassembly. Manual labor is minimum as the pressure backwash cleaning requires only the operation of a few valves. Only Adams filters reverse liquid flow at necessary high velocity and pressure to effectively clean the filter medium.

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9 Devine Vacuum Chamber Dryers; from Lab. Size to No. 36 Double

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2 MONEL Reactors, 2800 Gal. with Turbine Agts. Jktd. 175# ASME

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47 Teismith TY Gyratory Crusher.

—We more 28 H. MiS. Plants.

No. 5660 Dixle Mogul Hammermill 500 H. P.

—67 x 36 Hardinge Ball Mills 4½ x 2º KVS.

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LIQUIDATING

T316 SS CHEMICAL EQUIPMENT ORANGE, TEXAS

- 1—Struthers-Wells 3500 gal. T316 SS reactor, jkt. & 40/20 HP Agit., w/int. T316 SS coil
- 1-Alco 110 sq. ft. T316 SS vert. pressure leaf filter.
- 2-Vulcan 96" dia, T316 SS bubble cap columns, 37' high
- 1-Vulcan 72" dia. Copper column, 4' high, VACUUM.
- 1-17,650 gal. T316 SS horiz. tank, dished heads, coil
- 3-Worthington 160 ton steam-jet Vac. refrigeration units.
- 2-Sharples #C-20 Super-D-Hydrators, T316 SS
- 2-Buffalo type #R, T316 SS blowers, 2330 cfm, 60 HP
- 2-American type #R, T31 SS blowers, 5600 cfm, 50 HP
- 2—Read 1800 cu. ft. T304 SS weigh hoppers, with T304 SS elevators, shaker conveyors, etc.
- 1-Struthers Wells 630 sq. ft. T316 SS evaporator.

MANY, MANY OTHER ITEMS
SEND FOR ILLUSTRATED CIRCULAR #1259A

TANKS-VESSELS

- 2-18,000 gal., vert. alum., 12' x 31', cone bottom
- 1-17,650 gal., horiz., T316 SS, 9' x 36', ¼" shell, ¾" dished heads, 40# WP.
- 1-5800 gal., vert., alum., 10' x 10', agit.
- 10-4500 gal., vert., Nickel-clad, 8' x 11', 125# WP.
- 1-3700 gal., vert., T304 SS, 6' x 17' VACUUM, int. coils.
- 1-3300 gal., vert., T304 SS, 6' x 14'6", 36" shell, 36" heads, 70# WP.
- 1-2750 gal., vert., T316 SS, 7' x 8', dished heads, 50# WP, 75 sq. ft, coil.
- 4-2600 gal., vert., T316 SS, 7' x 8', flat bottom, 19# WP, 5 HP agit.
- 1-2500 gal., vert., T316 SS, 7' x 7', 1/4" shell, 5/16" dished heads, 70# WP.
- 5-2250 gal., vert., T316 SS, 7' x 6'3", dished heads, 70# WP, 5 HP agit.
- 1-2100 gal., vert., T316 SS. 6' x 9'10" open top, cone bottom
- 1-2100 gal., vert., 6' x 10', dished heads, rubber lined.
- 1-2100 gal., vert., alum., $6' \times 10'$, dished heads.
- 1-1900 gal., vert., T316 SS, 6' x 8', 36" shell & dished heads, VAC. or 100#.
- 12-1750 gal., vert., hoppers, T304 SS, double cone bottom.
- 100-Tanks & vessels, 100 to 1000 gal., all types, etc.

JUST PURCHASED

- 1-Buflovak 5' x 30' Rotary Vac. Dryer, T316 SS. ASME
- 1—Baker-Perkins #15-UUMM 100 gal. Dispersion mixer, 100 HP, jacket, compression cover, screw tilt, cored blades
- 2-Buflovak VACUUM Shelf Dryers; 110, 98 sq. ft.
- 3—10' dia. x 78' long rotary dryers, ¾" shell

FILTERS-CENTRIFUGALS

- 1—Niagara #510-28, 510 sq. ft, vert. lead, T316 SS. ASME.
- 1-Alco 110 sq. ft T316 vert. filter.
- 1-Niagara #60-20 T304 SS Filter.
- 1-Niggara #53-36 T304 SS filter.
- 2—Oliver 5'3" dia. x 3' face rot. vac., pressure precoat. T316 SS. ASME 30# pressure housing.
- 1—Oliver 5'3" dla. x 8' face, rot. vac., precoat, steel; UNUSED.
- 2—Sperry 30" P. & F. filter presses, 19-9 st. st. (NI-RESIST).
- 39—Sharples #AS-16V super cent. Inconel, Vapor-tile, 3 HP, sludge disch.
- 2-Sharples #16P, T304 SS pressure-tite.
- 5—Sharples #C-20, C-27 Super-D-Hydrators, T316 SS.
- 3-Bird 24" x 24" monel Type CH cent.
- 1-Bird 32" x 50" horiz. cent., T316 SS.

HEAT EXCHANGERS— CONDENSERS

- 1-1960 sq. ft. T316 SS exchanger, ASME.
- 1-1450 sq. ft. T316 SS vert, condenser.
- 7-800 sq. ft. T316 SS vert. condensers.
- 5-400 sq. ft. T316 SS vert. condensers.
- 50—T316 SS condensers & exchangers: 735, 427, 300, 264, 250, 235, 200, 185, 150, 125, 110, 47, 30 sq. ft.
- 25-Copper & cupro-nickel exch. & cond.

CLOSING OUT

CRUSHING-GRINDING PLANT MANCHESTER, CONN.

- 13—Abbe Eng. #18 pebble mills, 6' dia.
 x 8' long, buhrstone lined, 30 HP
- 2-Hardinge 7' x 36" conical mills,
- 1—Allis Chalmers 6' x 18' pebble mill.
- 1-Symons 3' short head cone crusher.
- 1—Buchanan 13" x 24" JAW CRUSHER.
- 3-Bucket elevators, up to 50' high.

SEND FOR CIRCULAR #360A

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BUY BRILL

CENTRIFUGES

Sharples C-27 Super-D-Hydrator, 316 S.S. Monel. Bird 18"x28", Solid Bewl, Continuous, 316 S.S. Bird 36"x36", Selid Bewl, Continuous, 347 S.S. Sharples PY14, PRIA Super-D-Cantors 316 S.S. Tolhurst 26" susp. Rubber Imperforate Basket. Tolhurst 32" susp. 317 S.S. Perforated Basket.

REACTORS, EVAPS, ETC.

650 gal. 304 S.S. Reactor with 100 sq. ft. Bayonet Heater. 1400 gal. Blaw-Knox, steel, jacketed, agitated Reactor. 550 sq. ft. Buflovak monel single effect Evapora-

tor. 7390 gal. 316 S.S. Vert. Storage Tank, 7'x25', 50 psi. 750 gal. nickel clad Mixing Tank, 125# nickel colls.

730 gal. micker class reaction.
colls.
4000 gal. Haveg Vert. Tank, 8'x12'.
1500 gal. Stainless Pressure Tank, 5'x10', 90#.
12,000 gal. horiz. steel Pressure Tank, 7'6'x38',
200 pal.
Stainless Heat Exchangers, 1220, 786, 536, 370,
315, 250 sq. ft.
Falls Industries 100 sq. ft. Karbate Condenser.
24" dia. x 35', 304 S.S. Bubble Cap Column.

FILTERS

Oliver 6' die. Horizontal Filter, 316 S.S. Oliver 3'x6' Steel Rotery Vacuum Precoat Filter. 3'x2' S.S. Rotery Filter. U.S. 200 eg. fr. 304 S.S. Auto-jet Filter. Oliver 5'3"x8' Steel Rotery Vacuum vaportite housing.

housing. faine 5'6' Stainless Steel Rotary Vacuum Filter. #10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

DRYERS

Buffovak vacuum Shelf with 20-60"x80"

Buflovak vacuum Shelf with 20—60"x80" shelves.
Devine Vacuum Shelf with 10—40"x43" shelves.
Buflowsk 42"x120" deuble drum Dryers.
Devine 4"x9", single drum, atmospheric.
Buflowsk 3"x10" Retary Vacuum Dryer.
Bonnet 5"x40" Rotary Vacuum Dryer.
Louisville Rotary Steam Tube 6"x25", 6"x50".
Lesisville 8"x50" Steinless Steel lined Rotary
Bruers.

Dryers. Rotary Dryers, 34"x30", 6'x50", 6'x60", 7'x80", 8'x87".

8'x87'. Traylor 30"x18' Stainless Steel Rotary Dryer. Atmos. Tray Dryers, 16 shelves, 40"x24". P&S 10' wide Apron Conveyor Dryer 48' long.

MIXERS

Banbury #8, 7½ H.P. U.S. Vari Drive. Baker Perkins 100 gal., jacketed, double arm, 30 HP. Baker Perkins #16TRM, 130 gal., jktd., Vac. 60

Baker Perkins 50 gal. (acketed, double arm. Baker Perkins 9 gal.) acketed 304 S.S. double

arm.
Day "Cincinnatus" double arm, 250 and 100 gal.
3' dia. Simpson intensive Mixer.
Stokes 21K, 304 S.S. Granulating Mixer 32 gal.

MISCELLANEOUS

Farrel 8"x16", 2 Roll Mill, 15 H.P. ISH, ISI Mikro Pulverizers, 3 HP. Abbe 21/2x3' porcelain lined Pabble Mill XP

ADDE 272A0 motor.
motor.
Abbe #4 Eureka Jar Mills, 21 gals.
Raymand 10' dia. Single Whizzer Separator.
#5 Miltre Atomizer with motor and cyclone.
Bantam Mikro Pulverizers, S.S.
No. 1 Ball & Jewell Rotary Cutter.
Swenson Walker Continuous Crystallizers, 24" x

30' sections.

#12 Rotex Sifter 20"x40", double deck; #22
Rotex Sifter 40"x56", double deck.

#24 Rotex Sifter, 20"x64", Quadruple deck.

F24 Rotex Sifter, 20"x64", Quadruple deck. Presses. Nash Vacuum Pumps: H6, TS7, #2.

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CIRCLE Q ON READER SERVICE CARD

EQUIPMENT

Raymond 3 Roll #3036 Hi-Side Mill Buflovak 18 Shell Vacuum Sheli Dryer 1000 sq. ft. Stainless Heat Exchangers (2) Tolhurst 40" S.S. Center Slung Centril. Fletcher 40" Susp. Steel Centrifugal Sweetland #12. #10. #7 Flier Presses 30 Gal. S.S. Jktd. Autoclave 1000 PSI Int. Shriver 30"x30" PSF 36 C.I. Chambers Nooter 750 gal. Sieel Reactor 300 PSI Traylor 8' x 11' Bell Mill Allis-Chal. 8'x60"x54" Welded Rotary Kilns Vulcan 6'x124'x25" Rotary Kiln Link Belt 502-16 Roto-Louvre Dryer 8' x 60' Rotary Dryer 316 S.S. Valcan v S. 16 Roto-Louvre Dryer 8' x 80' Rotary Dryer 316 5.5. Mosser 4' x 47' Rotary Dryers Louisville 6'x50'; 8'x25' Steam Tube Dryer Stainless Tanks 100, 200, 350 gal. Condensers 100 to 5000 sq. ft. Steel; Admir. Pressure Vessels 300 to 4500 gal. Dixie #5060 Mogul Hammermill Raymond #50, #40 Impact Mills

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MONEL DRYER

Louisville 54" x 35' long Rotary Monel Steam Tube Dryer. 1120 sq. it. heating surface. 150# pressure. Code construc-tion. New 1954.

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CIRCLE S ON READER SERVICE CARD

2 colloid Mills 40 HP EX. PR. Dowtherm 225 KW

Stokes R Tablet

50 gal. S.S. Autoclave 2000 lbs. pressure 31/2 gal. S.S. Autoclave 2000 lbs. pressure

Vulcanizer 60" x 9' 125 lbs.

Sweetland #2 all stainless

Stainless steel Ball Mill

Proctor & Schwartz finned drum driers

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OUTSTANDING VALUES!

Readco 25 gal SS vac mixer. Hersey rot hot air dryer, 11/2' x 16'. 400 gal \$5 agit reactor. 80 gal SS agit autoclave, 500 PSI.

CHEMICAL & PROCESS MACHINERY CORP. 50-52 9th St., Breeklyn 15, H.Y. HY-9-7200

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COMPRESSORS

AMERICAN AIR COMPRESSOR CORP. hem. Roud, North Bergen, N.J. UNion 5-1397

CIRCLE V ON READER SERVICE CARD

Oliver Rotary Vacuum Filter

74" dia. by 51" face, cloth covered open drum, stainless steel contact parts, good

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24" x 45", 10 gauge, 400 PSI, type 304, ¼ "pipe thread each end. NEW, \$300 value, \$99.50. Size 8½" x 18", 16 gauge, \$14.50. Case of 8, \$14.25. F.O.B. Baton Rouge, Louisiana.

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There's a lot to like ın CHEMICAL PROCESS EQUIPMENT

- -Williams 4 roll Comet size mill, complete with all aux-
- ilary equipment. Louisville rotary indirect heated dryer, 7' x 40', com-
- plete Steel ball mill 7½' x 7', complete with full charge of steel balls and drive.

AUTOCLAVES, KETTLES AND REACTORS

- 2—Pfaudier 200 gal. glass lined jacketed reactors, complete with anchor type agitators and drives

 1—Struthers Wells type 316 35 jacketed reactor, 2000 gal., complete with agitator and drive.

 1—Struthers Wells type 316 35 400 gal., reactor with cells and turbine type agitator and drive, 250. colls

 1—Pfaudier 300 gal. 55 jacketed kettle, 76 psi jacket, 75 psi internal pressure.
- Pan Alst 250 gal. SS jacketed kettle, complete with SS column and condenser 1—Pfaudler 200 gal., type 316 SS jacketed reactor, 75 psi jacket, 20
- 1—Producter 200 qui., type vie as painternal painternal 2—Monel 2500 qal, jacketed autoclaves, 175# jacket, 175# internal 1—Autoclave Engineers type 316 SS autoclave, 1 qal., complete with motor, drive and colls, 1200# working pressure 2—Blaw Knox 600 qal, steel reactors, complete with double motion agitators and drives, 50# jacket, 50# internal 1—18,000 qal, aluminum storage tank

DRYERS

- —Allis Chalmers SS 6' x 50' rotary dryer, complete

 —Allis Chalmers rotary dryers, 6' x 50' and 7' x 60'

 —Link Beli steel roto louvre dryers, Model 207-10, 310-16, \$04-20

 —Stokes Model 39DS steel rotary vacuum dryer, 5' x 30'

 —Louisville rotary dryers, 8' x 50', SS

 —Bullovak steel jacketed rotary dryers, 3' x 15', 5' x 20', 5' x 35'

 —Traylor 4' x 40' rotary dryer

 —Bowen SS pilot plant spray dryer

FILTERS

- 3—Dorrce rubber covered filters, 8' x 2'
 2—Sweetland #12 filters with 72 SS leaves
 1—Miagara SS filter, Model 510-28
 1—Oliver SS rotary pressure precoat filter, 5'3" x 8'
 1—Oliver type 316 SS rotary vacuum filter, 4' x 5'
 1—Oliver horizontal filter, 3' x 8"
 1—GATX SS pilot plant filter, 2' x 8"
 0—Shriver plate and frame filter presses, 12" to 42"
 1—Shriver aluminum 30" x 30" P&F filter press, 30 chambers

- 1—A75M 48" SS suspended type centrifuge, complete with plow, motor and imperiorate basket
 1—Fisicher 48" center slung SS centrifuge, complete with perforate basket and motor
 8—Wistern States 40" type 316 SS suspended type centrifuges, complete with perforate baskets, plows and 40 HP motors. Year built 18:3
 1—A75M 48" SS suspended type centrifuge, complete with plow, mitor and perforate basket.
 4—Tc.hurst center slung rubber covered centrifuges, with perforate biskets and motors
 2—Jetcher 40" center slung rubber covered centrifuges with perforate baskets and motors



THE GELB GIRL-JULY 1960

MIXERS

- 2—Sturtevant #7 dustite rotary batch blenders, NEW 15—Robinson type 304 SS horisontal blenders, 255 cu. ft. 1—Baker Perkins Sise 20, 2000 gal. double arm jacketed vacuum mixer
- with double naben blades
 Baker Perkins Sise 16, Type UUEM, 150 gal., jacketed double arm
 dispersion type mixer, complete with compression cover and 100
- 2—Baker Perkins 20 gal. SS jacketed vacuum double arm mixers 1—Stokes SS granulating mixer, Model 21-J 1—Entoleter impact mill type PPM-27

MISCELLANEOUS

- Girdler SS jacketed cooling votators, 24" x 6', complete—Girdler SS jacketed heating votators, 10" x 62", complete—Vulcan SS bubble cap column, 4' x 25 Plates—Badger type 316 SS bubble cap column, 42" dia. with 11 trays—Sadger type 316 SS bubble cap column, 35" dia. with 8 trays—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.—Condenser Service type 316 SS heat exchanger, 330 sq. ft.—Badger type 316 SS heat exchangers, 500 sq. ft. and 800 sq. ft.—Davis Engineering Carp. 20, 125 sq. ft. heat exchangers, NEW—Dowington type 316 SS heat exchanger, 750 sq. ft.—Mikro Model ISH pulverizer—Swenson type 316 SS vacuum crystallizer, 3'6' x 12', 2' x 12'—Williams type 316 SS hammermills, Model AK—Sprout Waldron Model 501-D pelleter—Ross 8" x 14", 3 roll paint mill, complete—Mikro SS model 15H pulverizer, complete

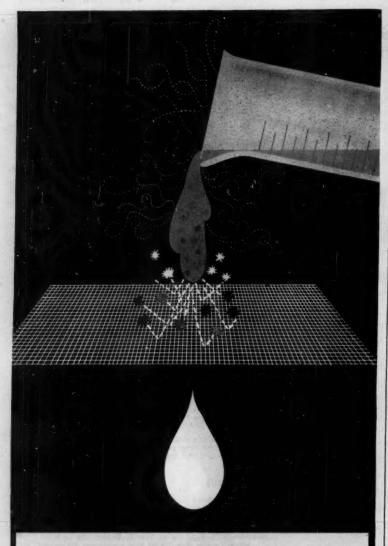
& SONS, INC.

- –Buflovak 42" x 120" double drum dryers –Hersey stuinless steel rotary dryer, 18" x 12', complete
- Buflovak stainless steel jacketed rotary vacuum dryer, 3' x 15'
- Richmond Engineering type 316 SS horizontal double ribbon blender, 40 cu. ft.



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INDEX OF

ACIE Traductules	Tona	
ACF Industries, WKM Division Adams Co., R. P. Aerotec Industries	inc.	141
WKM Division		141
Adams Co., R. P.	***********	204
Aerotec Industries	, Inc	156
Allied Chemical C	Corp.	
General Chemic	al Div	59
Solvay Process	Div	79
Allis-Chalmers	137,	139
Allied Chemical C General Chemical Solvay Process I Allis-Chalmers Aluminum Co. of Petro Chemical Rome Cable Div	America	
Petro Chemical	Div10	0-11
Rome Cable Div		1-25
Rome Cable Div American Chain & R-P & C Valve American Hard R American Meter C Pump Division . American Optical	& Cable Co.	
R-P & C Valve	Division	46
American Hard R	ubber Co	157
American Meter C	0.	
Pump Division		172
American Ontical	Co	168
American-Standar	d	200
Industrial Divisi Armco Steel Co. Armour Industrial Armstrong Machin Artisan Metal Proc	on	47
Armeo Steel Co	OII	51
Armour Industrial	Chemical Co.	8-7
Armetrong Machin	Onemical Co.	101
Artison Machin	he works	100
Artisan Metal Proc	iucis, inc	100
Babcock & Wilcox Products Div., I Bailey Meter Co., Barber-Greene Becco Chemical D	Co.; Tubular Fittings Dept.	100 182
Barber-Greene		-13
Becco Chemical D	ivision. Food	100
Machinery & Ch	emical Corp.	143
Machinery & Ch Beckman Instrume	ents. Inc	195
Bird Machine Co		2
Bufalovak Equip	. Div	190
Bufalovak Equip Borg Warner Mecl	hanical Seals	164
Buffalo Forge Co		49
Burgess-Manning	Co.	202
Cambridge Wire Cl Carborundum Co.	oth Co	103
Carborundum Co.		151
Carborundum Co. Celanese Corp. of A	merica	75
Chain-Belt Co.		
Carrier Conveyor	r Division	169
Chemtrol		174
Chicago Bridge &	Iron Co	81
Clark Brees One o	f the	
Dresser Industrie	as Inc 22	-23
Cleaver Brooks Co	and allower	186
Combustion Frais	earing The	100
Cleaver Brooks Co. Combustion Engin Raymond Divisio	receing, inc.	100
reaymond Divisio	**	194

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Davenport Machine & Foundry	200 211 211 173 -57
Duriron Company, Inc., The	135
Eimco Corporation Second Cov Electric Controller & Mfg. Co., Div. of Square D Company Elliott Company	89 60 er
Falk Corp. Falls Industries, Inc. Federated Metals Division, American Smelting & Refin-	67 45 67
Fisher Governor Co	38 87 83
Gardner-Denver Co	55 33 13 21
Goodyear Tire & Rubber Co Goslin-Birmingham Mfg. Co 18 Goulds Pumps, Inc 18	73 92 91
Hallikainen Instrument Co.	4 78 19 13 15 13
Illinois Water Treatment Co 19 Imperial Brass Mfg. Co 19 Ingersoll-Rand 8	
Johns-Manville (Packings) 3	3
Kaiser Aluminum & Chemical Corp. 16 Kellog Company, M. W. 9 Kemp Mfg. Co., C. M. 3	1
LaBour Company	6
Manten Gantin 186- G- 100	0
Manton Gauin Mrg. Co. 19 Marley Co. 19 Marsh Instrument Co. Division of Colorado Gas & Oil Corp. 20 McGraw-Hill Book Co. 21 Mine Safety Appliances Co. 34-3 Minneapolis-Honeywell 26-2 Morehouse-Cowles, Inc. 3-2	3 2 5 7 7 7
Nalco Chemical Co	3
National Carbon Co., Div. of Union Carbide Corp. 33 National-Standard Co. 46 Newport News Shipbuilding & Dry Dock Co. 46 Nicholson & Co., W. H. 185	3
Nicholson & Co., W. H 165	

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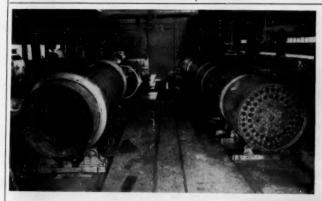
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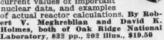
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Memphis Light, Gas & Water Div	208
Perry Equipment Corporation	207
Stanhope, Inc., R. C	206
Union Standard Equipment Company	206

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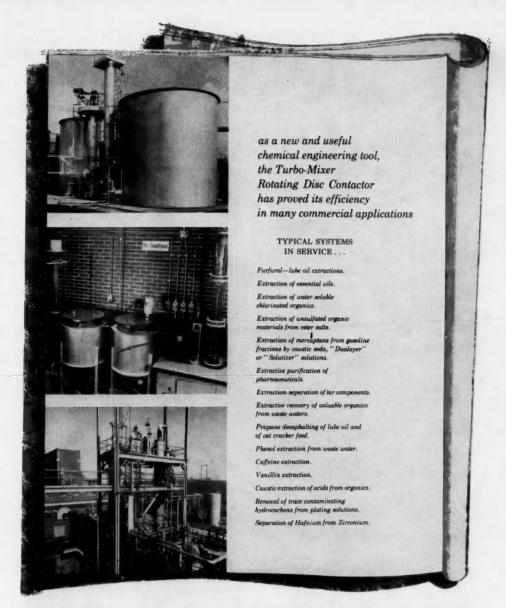
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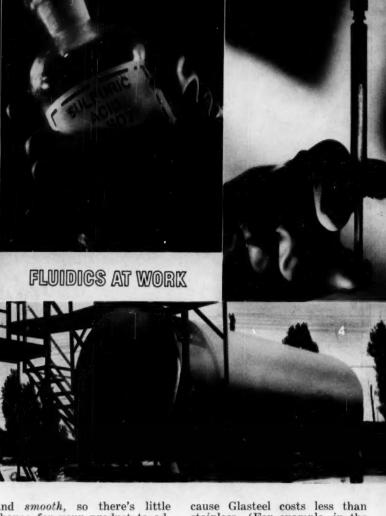
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